

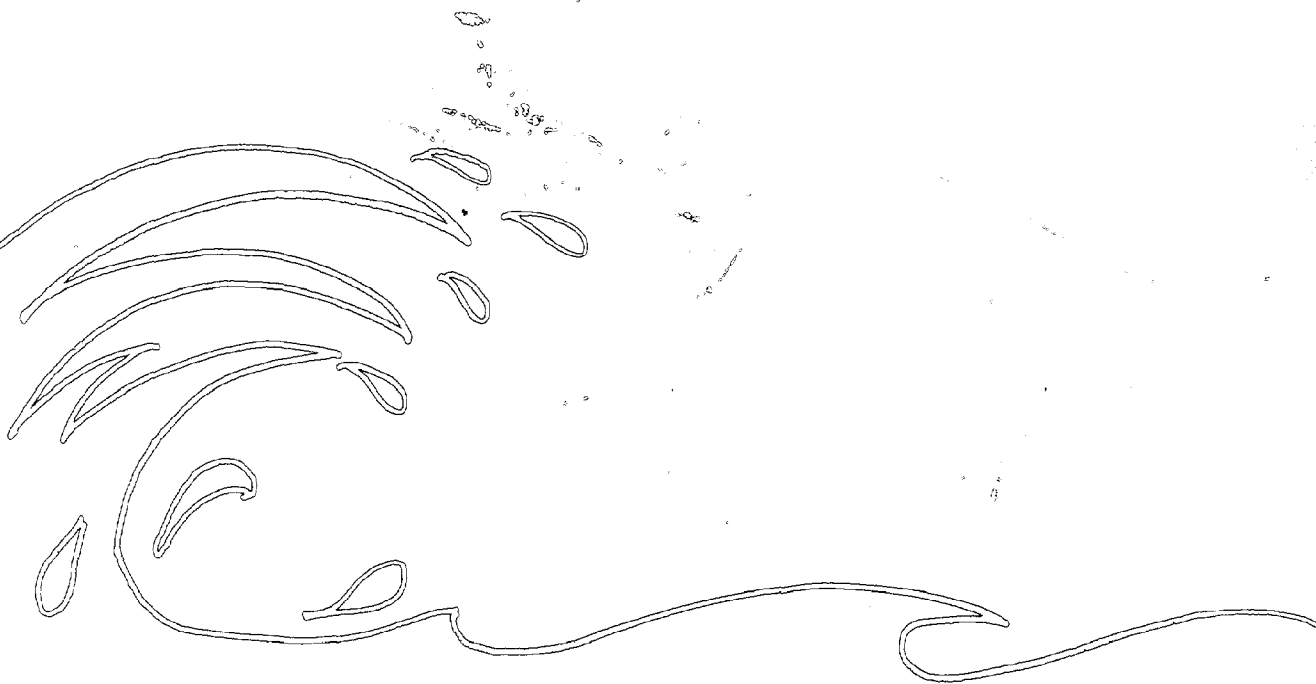
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Puerto Rico, Commonwealth of



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P U E R T O R I C O A N D T H E S E A

--AN ACTION PROGRAM FOR MARINE AFFAIRS--

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A Report to the Governor

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PUERTO RICO AND THE SEA
Old San Juan, Puerto Rico

October 19, 1972

The Honorable Luis A. Ferré
Governor, Commonwealth of Puerto Rico
La Fortaleza
San Juan, Puerto Rico

Dear Governor:

In response to your request earlier this year, we are pleased to submit our recommendations to you for an action program for marine affairs for Puerto Rico. The seas that bound the Island, through their resources and their interactions with the coastal lands, give an increased dimension to Puerto Rico. Prudently used, this new dimension will allow Puerto Rico to expand the quality of life of its citizens far beyond what is seemingly allowed by its small land mass.

In writing this program, about one hundred marine-oriented citizens from many enterprises worked together on a voluntary basis. Most of them served on the six Subcommittees, whose findings and recommendations form the basis for "Puerto Rico and the Sea." We want you to know how very freely these individuals gave their time and facilities to ensure the worth of this report.

The members of the Parent Committee and its Subcommittees would be honored to again serve you and the Commonwealth.

Very respectfully submitted
by the Parent Committee,

Rafael Alonso Alonso
William S. Beller, Chairman *W.S.B.*
Roberto Bouret
Miguel A. Casellas
Máximo Cerame-Vivas
Amador Cobas
Juan M. García Passalacqua
Thomas Q. Haydon Navarro
Lawrence W. Hill
Rudolph R. Kauffmann *R.R.K.*

Gordon K. Lewis
Jaro Mayda
Cruz A. Matos
Jack Noble
Rafael Picó
Milton F. Rúa
Victor Sánchez
Lloyd E. Slater
José J. Villamil
Frank Wadsworth

PUERTO RICO Y EL MAR
Viejo San Juan, Puerto Rico

Octubre 19, 1972

Honorable Gobernador Luis A. Ferré
La Fortaleza
San Juan, Puerto Rico

Estimado Gobernador Ferré:

Respondiendo a su petición del 2 de marzo del 1972, nos complacemos en someter nuestras recomendaciones para un programa de acción para los recursos marinos de Puerto Rico. Los mares que nos rodean con sus recursos y su interacción con los terrenos costaneros, le proveen una dimensión adicional a nuestra Isla. Utilizada prudentemente, esta dimensión le proveerá a Puerto Rico la oportunidad de mejorar la calidad de la vida de sus ciudadanos, más allá de lo que le permitiría su limitada extensión geográfica.

Alrededor de cien ciudadanos interesados en asuntos marinos participaron voluntariamente en la redacción de este documento. Representantes de diversas profesiones y ocupaciones trabajaron en los seis Sub-comités cuyos hallazgos y recomendaciones integran el informe de "Puerto Rico y el Mar". Estos ciudadanos nos brindaron gratuitamente su tiempo y sus talentos para asegurar el éxito y la validez de este informe.

Los miembros del Comité Timón y de los Sub-comités nos sentiríamos honrados de servirle a Vd. y a Puerto Rico nuevamente.

Muy respetuosamente sometida
por el Comité Timón,

Rafael Alonso Alonso
William S. Beller, Chairman
Roberto Bouret
Miguel A. Casellas
Máximo Cerame-Vivas
Amador Cobas
Juan M. García Passalacqua
Thomas Q. Haydon Navarro
Lawrence W. Hill
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FOREWORD

"Puerto Rico and the Sea" is a citizen's report on marine affairs to Governor Luis A. Ferré. It prescribes an action program for the Commonwealth with the aim of enlarging the well-being of Puerto Rico by taking prudent advantage of its great natural resource--the sea.

This report results from the direct request of Governor Ferré who asked that he "might have the advantage of seeing recommendations from an informed cross-section of our citizenry." Noting that "the future of Puerto Rico lies more and more in the resources the sea can bring us," the Governor said "we must plan to use these resources so they bring not environmental frustration, but more jobs, food and pleasure to our citizens."

About one hundred citizens of Puerto Rico participated in "Puerto Rico and the Sea"; most of them actively worked on the committees. Many of these people have for years worked on matters involving the sea and its meaning to Puerto Rico. These participants included scientists, planners, lawyers, journalists, bankers, students, builders, governmental officials, and academicians.

Although these people were in the main attached to different organizations in Puerto Rico, they contributed solely as interested

citizens having special and needed knowledge. This way of proceeding permitted them to base their discussions and recommendations on the touchstone of what is best for Puerto Rico. It also led to a balanced approach to marine matters, where the need for developing resources joined with the simultaneous need to conserve them.

This report was organized and written in four months. It could not have been done in this short time if entirely new knowledge had been sought. The philosophy was that many citizens of Puerto Rico know what the marine opportunities and problems are. In addition, decades of studies exist on marine problems in Puerto Rico, many of whose writers would help with the report. It was further believed that if Puerto Rico waited until all relevant studies on marine matters were in hand, by that time many of the questions would be academic. A time for decision-making must come! It was thought to be now! With this belief, the participants in "Puerto Rico and the Sea" strove to make viable recommendations for a coherent marine affairs program.

Just as all elements of life in the Island are affected by the sea, so are local programs affected by those of the Federal Government, other Caribbean governments, and the business and university community. Thus, this report calls for actions by any agency, wherever located, that could most appropriately

perform them.

How work was done

The research and writing for "Puerto Rico and the Sea" was done mainly by six Subcommittees, which had assignments in major fields of marine opportunities:

- Living Resources
- Recreation
- Coastal Zone Management
- Research and Development
- Institutional Arrangements
- Role of Puerto Rico
in the Caribbean Area

The Institutional Arrangements Subcommittee was created to allow the other Subcommittees to concentrate on their primary fields of interest.

Each Subcommittee met on the average of once a week for the four-month period, defining issues, hearing witnesses, and arriving at tentative and ultimately final conclusions.

The chairmen and vice-chairmen of each of the Subcommittees were members of the Parent Committee, which also included several additional members. The Parent Committee acted as the steering and integrating committee for the Subcommittees. It met several

times at all-day and two-day sessions during the course of the project to make its suggestions to the Subcommittees. However, each Subcommittee, when writing its own report, had only to consider the advice of the Parent Committee. It is remarkable that despite wide divergencies of interest among the participants on the project, the advice of the Parent Committee was accepted by all Subcommittees.

A few redundant or overlapping recommendations may be noticed, which the Parent Committee and Subcommittees felt were signs of strength and reinforcement, and not worth sacrificing in their entirety on the altar of brevity. In fact, were there no redundancies, the fear might have been expressed that the committees were not aware of the interrelationships that exist in marine affairs on a small ocean island.

In its own report, the Parent Committee has attempted to highlight and summarize those recommendations it believes have the most significance for Puerto Rico. Nevertheless, the choices were difficult to make. All recommendations are believed important, and the reader is urged to pursue them in this light.

The Parent Committee for "Puerto Rico and the Sea" was organized, and the project directed by William S. Beller, on loan to Puerto Rico from the U. S. Environmental Protection Agency.

ACKNOWLEDGMENTS

Surely there must be a fitting way the Parent Committee can publicly show the gratitude it has toward the many people who helped create this report. Yet the brief words that follow are the only means we know. We ask those who have helped us solve our past problems to understand our present one; and know despite what is left unsaid that even with more words we could not possibly relate our deep gratefulness.

We are indeed indebted to the members of all of the Subcommittees, and to the many organizations who donated the time of their personnel and the use of facilities. Please look at the List of Committee Members and their affiliations to get an idea of the broad support we freely received from Government, industry and the university community.

We want particularly to thank Governor Luis A. Ferré who requested the project, and then gave us without pause the encouragement and facilities we needed to allow us to meet every deadline and complete the report on schedule.

We appreciate the cooperation of William D. Ruckelshaus, Administrator of the U.S. Environmental Protection Agency, for his cooperation as well as assignment of personnel.

We want to say how very much we were helped by Lawrence Duffy, Assistant to the Governor. He gave us good advice as well as total assistance and support. Every request that we made to him, without exception, was filled graciously and in timely fashion.

Cruz A. Matos, Executive Director of the Environmental Quality Board and Lloyd E. Slater, Director of the Institute of Social Technology, were instrumental in launching "Puerto Rico and the Sea," and unstintingly gave of themselves and their organizations in fashioning the final report.

The project could not have proceeded were it not for the Mining Commission, and Pedro Gelabert, its Executive Secretary. He graciously made certain that his office gave us whatever aid we sought.

Nor could we have operated without the continuing help of Fomento, and particularly Manuel A. Casiano, the Administrator. Other Fomento personnel who assisted us beyond any call of duty were Gerardo E. Maldonado, Rudolph Kauffmann, Adolfo Mendez Ríos and Miguel Hernández.

In what sequence do we name those who have helped us? Certainly the Governor's Washington office, through its Administrator, Luis Guinot, Jr. greatly encouraged the start of the project, and aided us with valued advice and help from the Washington vantage point.

Staff members Gilda M. Iriarte and Richard Falknor were in constant communication with our staff.

We must also thank Resident Commissioner Jorge Luis Córdova Díaz, who personally and through his office assisted the project.

Other individuals who deserve special mention for their contribution of help and facilities include Máximo Cerame-Vivas, Thomas Q. Haydon, and Rafael Benítez Carle who furnished the extraordinarily good service of the Hotel El Convento which housed our offices. In addition, we want to thank Manuel A. Martinez Suarez, Chief of Transportation and Wilfredo Morales Díaz, Assistant Deputy to the Governor, who with great understanding and consideration went considerably out of his way on many occasions to get us the facilities and supplies we needed. We want to tell Ernie Potvin of the Creative Group of our appreciation for his artistic contributions. We want to thank Luis Morera for his help on several difficult legal questions.

Staff

Margarita Gandía as Project Coordinator was intensely valuable for her ideas, enthusiasm, knowledge of Puerto Rico and boundless energy. Without a doubt, her fine work enabled us more easily to fit the pieces of the project together at its conclusion.

María Elena Matos López, who was hired as the Executive Secretary became the Office Manager and expeditor, assumed half a dozen other duties, and accomplished them all in exceptionally good fashion although heaven knows how.

The report was edited by Irma Gual Rexach and Annette Biscombe de Ramirez Arellano, and they also translated into Spanish the introductory material as well as the Parent Committee chapter under impossibly short deadlines. We wish to praise them loudly and publicly. Annette Biscombe also created the cover of the Preprint.

We want to thank our summer interns. And lastly we indeed appreciate the work of Pamela Toro and Pat Cornelison, who along with the entire staff worked harder than anyone has a right to expect.

PROLOGO

"Puerto Rico y el Mar" es un informe sobre asuntos marinos sometido al Gobernador Luis A. Ferré por un grupo de ciudadanos. El informe recomienda un programa de acción para Puerto Rico con el propósito de mejorar la calidad de la vida en nuestra Isla utilizando prudentemente su gran recurso natural - el mar.

El informe surgió de la petición del Gobernador Ferré, quien solicitó "la oportunidad de obtener las recomendaciones de un sector informado de nuestra ciudadanía". Señalando que "el futuro de Puerto Rico depende cada vez más en los recursos que el mar nos pueda aportar", el Gobernador indicó que "debemos planificar el uso de estos recursos, de tal manera que su explotación no sea detrimental para nuestro ambiente, sino que sea proveedora de mas empleos, alimentos, y una vida más placentera para nuestros ciudadanos".

Alrededor de cien de nuestros ciudadanos participaron en el proyecto "Puerto Rico y el Mar"; casi todos trabajaron activamente en los diversos comités. Muchas de estas personas tienen una vasta experiencia trabajando en asuntos relacionados con el mar y su significado para Puerto Rico. El grupo de participantes incluyó científicos, planificadores, abogados, periodistas, banqueros, estudiantes, constructores, oficiales gubernamentales y académicos.

Aunque estas personas provenían de distintas organizaciones locales, todos participaron únicamente como ciudadanos preocupados e informados contribuyendo gratuitamente sus conocimientos y destrezas especiales. Esta manera desinteresada de proceder permitió que sus discusiones y recomendaciones pudieran basarse en el criterio de lo que mejor conviene a Puerto Rico. Este procedimiento también los llevó hacia un enfoque equilibrado de los recursos marinos, donde la necesidad de desarrollar los recursos va simultáneamente ligada a la urgencia de conservarlos.

La organización y redacción de este informe tomó cuatro meses. Esto no hubiese sido posible en tan corto plazo si hubiésemos tenido que recopilar conocimientos totalmente nuevos. Se partió de la premisa de que muchos ciudadanos de Puerto Rico conocían los problemas y las oportunidades en torno a los recursos marinos. Además, ya se habían llevado a cabo muchos estudios sobre problemas marinos en Puerto Rico y sus autores participarían en la preparación del informe. Se consideró también que si Puerto Rico tuviese que esperar hasta que se hicieran todos los estudios pertinentes antes de tomar medidas, muchos de los problemas se tornarían en consideraciones puramente académicas. Se concluyó que la hora de tomar decisiones ya ha llegado. Con ésto en mente, los participantes de "Puerto Rico y el Mar" trataron de formular recomendaciones factibles para un programa coherente de asuntos marinos.

Del mismo modo en que todos los aspectos de la vida de nuestra Isla son afectados por el mar, los programas locales también se ven afectados por los programas del Gobierno Federal, por los de otros gobiernos del Caribe, por los del sector comercial y los de la comunidad universitaria. Por lo tanto, el informe recomienda acciones por parte de cualquier agencia que pueda ejecutarlas con mayor efectividad, no importa donde esté ubicada.

Preparación del Informe

La investigación y redacción de "Puerto Rico y el Mar" fue llevada a cabo principalmente por seis sub-comités los cuales abordaron diferentes temas en el área de asuntos marinos:

- Recursos Vivientes
- Recreación
- Manejo de la Zona Costanera
- Investigación y Desarrollo
- Arreglos Institucionales
- Rol de Puerto Rico en el Area del Caribe

El Sub-comité de Arreglos Institucionales fue creado con el propósito de permitirle a los demás sub-comités a concentrarse en aquellos campos de su principal interés.

Cada sub-comité se reunió aproximadamente una vez por semana durante un período de cuatro meses. En estas reuniones se definió la problemática, se oyeron testigos y se llegaron a conclusiones tentativas y luego finales.

Los presidentes y vice-presidentes de cada uno de los sub-comités formaron parte del Comité Timón, el cual incluyó también varios miembros adicionales. El Comité Timón dirigió e integró a los distintos sub-comités, celebrando varias reuniones de uno a dos días de duración con el propósito de someter las sugerencias a los sub-comités. Sin embargo, al redactar su propio informe cada sub-comité tenía que considerar únicamente, el asesoramiento del Comité Timón.

Algunas de las recomendaciones se repiten en los informes de los distintos sub-comités; no obstante, el Comité Timón y los sub-comités creyeron que estas repeticiones fortalecerían el informe y no deberían sacrificarse en el altar de la brevedad. De hecho, si no hubiese redundancia alguna, podría interpretarse como que los sub-comités no estaban concientes de las inter-relaciones que existen en los asuntos marinos de una isla pequeña.

En su propio informe, el Comité Timón ha intentado resumir y poner en relieve las recomendaciones de mayor importancia para Puerto Rico. No obstante, fue difícil hacer la selección. Todas las recomendaciones se consideran importantes y se le urge al lector que

las considere como tal.

William Beller, de la Agencia de Protección Ambiental de los Estados Unidos, organizó el Comité Timón para "Puerto Rico y el Mar" y dirigió el proyecto.

OVERVIEW--REPORT OF THE PARENT COMMITTEE

INTRODUCTION

The citizens of Puerto Rico until recently were generally unaware of the important contributions that marine resources were making toward their quality of life. As a result, the Island had never developed the managerial and custodial ethics, and public policy needed to protect adequately or develop many of the assets of the sea.

As the Island shifted from agriculture to industry, new demands and stresses were placed on the surrounding sea. These grew as the population became more affluent and could afford the time and expense of marine-oriented recreational pursuits.

Tourism rapidly increased, bringing thousands of off-island visitors in search of tropical shores and the benefits these could offer. Urban expansion and industrial developments encroached on estuarine zones, along beaches and lagoons. Wetlands and swamps were drained or filled to make more room for an ever-growing community hungry for space. Beaches and dunes were exploited for sand needed for constructing homes, factories, office buildings, roads and runways.

Many rivers and coastal waters became choked with the sediments of land disturbances and domestic and industrial wastes. The

marine environment, the prime recipient of the abuse, suffered progressive damage, the full extent of which is still largely unknown.

Not all the damage to the marine environment was necessary or intentional. There was an underlying assumption on the part of developers, industrialists and the general public that marine resources could be exploited indefinitely. Indeed this assumption is true if the resources are used with forethought and wisely. It is this enlightened use that we seek.

Yet an ocean island such as Puerto Rico does have a limit to its capacity to withstand intensive use and development. Once this limit is passed, which is the state some of Puerto Rico's marine resources are fast approaching, the Island changes character for the worse. Where previously the effect of decisions with respect to the use of the marine environment was largely reversible, this is not often the situation now.

Our not seriously recognizing this crisis in our marine environment stems in part from Puerto Rico's penchant to use developmental patterns more suited to large land masses. Such a view dims the reality of Puerto Rico as a small, ocean island. As a result, priorities and solutions to problems more appropriate to large land masses have tended to be Puerto Rico's priorities and solutions.

The imperative for wise and balanced use of the Island's clearly limited marine resources, its restricted capacity for intensive

development of its shores, the false notion of Puerto Rico as a large land mass--all these factors lead to a call for immediate action. With this high degree of urgency, we offer the following recommendations for an action program in marine affairs for Puerto Rico.

COASTAL ZONE RESOURCES

The coastal zone is a complex area of habitats for a wide variety of marine and terrestrial plants and animals. It is a particularly fascinating area because of the way these life forms weave the land and sea together and intimately depend upon each other for survival. Healthy mangroves are efficient soil builders and serve as homes or nurseries for nearly two-thirds of our species of shallow-water marine fauna. Reefs and dunes moderate currents and wave actions to protect lagoons, shore vegetation, and beaches. The sea itself is the earth's largest unexplored wilderness-- a new frontier for man in his pursuit of recreational, scientific and industrial rewards.

Land Use And Development

The most dangerous threat to Puerto Rico's coastal zone is the virtually uncontrolled process of shorefront land development. At a time when the public still assumes that the process is largely

confined to the area near San Juan, unplanned development patterns are being rapidly established in virtually every sector of the Island's coasts. Approvals are being granted on a case-by-case basis, without benefit of effective planning or zoning, and with little or no public participation. Government agencies have unknowingly permitted, as they have for many years, the needless destruction of the Island's most precious resource, even though the means to protect it are readily at hand. Measures to assure an appropriate balance between the needs of development and those of preservation must be taken immediately. Public awareness and participation in the workings of the development process is urgently needed.

Recommendations

1. All concerned governmental agencies should hold public hearings, with appropriate public notice, before granting approvals (including the all-important "consultas de ubicacion"* in the Planning Board) for projects located within 200 meters of the sea.
2. The Governor should ensure that the Planning Board publish by the end of 1972 and every six months thereafter an up-dated map

*Initial siting consultation

showing the current status of all applications-for-approval of projects located within 200 meters of the sea.

3. The Governor should request from the Planning Board and the Environmental Quality Board a thoroughly reasoned plan and environmental analysis of the land between Boca de Cangrejos and the Loíza River; and should assure the public that no development of this particularly strategic and threatened area will be authorized until these documents are completed and publicly evaluated.

Policies, Plans, Implementation

The process of case-by-case project approval should be replaced as rapidly as possible by an orderly system that includes adopting rational policies and plans, and establishing measures to assure their implementation. The Subcommittee on Coastal Zone Management recommends a number of needed steps:

Recommendations

1. The Government should establish a formal policy requiring that coastal developments should preserve, to the fullest extent practicable, the natural character of the shorelands that surround Puerto Rico.

2. Comprehensive coastal-zone management policies and plans

should be adopted to provide for protection and development of the coastal zone. Measures to expedite the planning and decision-making processes, including measures enabling developers to help speed area planning, should be given particular attention.

3. The Legislature and administrative agencies should establish a system of Critical Environmental Areas to assure protection of phosphorescent bays, important reefs and mangroves, and other uniquely valuable areas. Regulations, maintenance arrangements, tax incentives and property purchase should be among the essential elements of such a system.

4. The Government should acquire control over the relatively few remaining sites suitable for ports, power plants, and heavy industry.

5. The Legislature should establish shorefront setback requirements and density limits by statute if agencies prove unwilling to establish them rapidly.

Access to Public Shorelands

Although public access to beaches and shorelands has seldom been a problem in Puerto Rico, new developmental patterns are now creating such problems for the future. Unless new controls are rapidly established, more and more beaches in outlying areas will be effectively set aside for the sole use of occupants of shorefront

hotels and condominiums.

Recommendations

1. The Government should adopt a formal policy assuring all people equal opportunity, in fact as well as in law, to enjoy the beaches and other public shorelands of Puerto Rico.
2. The Government should clarify existing public property rights in shorefront areas, including resolution of a number of legal issues.
3. The Government should establish by regulation, or by statute if necessary, minimum beach-access requirements, including prohibiting subdivision and development of extensive projects in areas where those requirements are not satisfied.

Energy

Unless new and practicable power-generating methods are developed, facilities for electric power generation will continue to be concentrated in the coastal zone. No amount of careful land-planning can protect our coastal resources if the present rate of increase in power usage is allowed to continue indefinitely. The time has come to ask how this rate of increase can be decelerated, while effectively satisfying legitimate demands. ,

Recommendation

The Government should develop over the next five years a coherent and realistic policy for the production and consumption of electric power.

Protection of Resources

A combination of factors, all ultimately resulting from a lack of adequate awareness and respect for natural processes, are causing the slow elimination of essential marine habitats.

Reefs and Mangroves

Under particularly heavy stress are the very efficient producers of marine life, the reefs and mangroves. To remove some of the stresses on them, and help recreate stable conditions in the surrounding environment, the Subcommittee on Living Resources has identified a number of needed measures.

Recommendations

1. A system of publicly-owned Marine Environmental Sanctuaries should be created and carefully coordinated with a system of similarly established Critical Environmental Areas.
2. The removal, transportation, possession, or sale of coral from any reef in Puerto Rican waters should be prohibited.
3. Spearfishing should be prohibited and undersea photography promoted.
4. All publicly-owned mangrove areas should be transferred to

the custody of the new Department of Natural Resources to become part of the Commonwealth Forest System.

5. A one-year moratorium on the development of any privately-owned mangroves should be declared, during which time the Department of Natural Resources should inventory and evaluate these areas and recommend public acquisition of appropriate ones.

Commercial Fishing

Scarcity of inshore fish, lack of knowledge of offshore resources, lack of modern methods and gear, obsolete fishing-craft, and unrealistic credit programs all help perpetuate the depressed state of most commercial fishing in Puerto Rico. Our nearly 3,000 fishermen earn, on the average, no more than \$1,600 annually. Yet recent tests reveal that at least a threefold increase in fisheries' production can be obtained, with the accompanying increase in earnings for the fishermen.

Recommendations

1. The Government should create a realistic fishermen's credit program.
2. The Government should provide a training program in seamanship, equipment maintenance, and small-business management.

Game Fishing

The intensive use of coastal waters has jeopardized recreational fishing around Puerto Rico. Governmental help is needed to remedy this situation, especially if local citizens and tourists are to continue to enjoy game fishing in our waters.

Recommendations

1. A program should be implemented to locate, inventory, and classify known and potential sport-fishing areas within which recreational fishing may be initially concentrated and further developed.

2. All existing laws and regulations pertaining to sport fishing should be evaluated, and recommendations made to the Legislature for a new updated and uniform set of laws with provision for effective enforcement.

Water Quality

Degradation of water quality is one of the most insidious destroyers of the living resources in the coastal zone. Not only the dumping of wastes into coastal waters but also such seemingly remote activities as upstream grading or use of fertilizers can

have harmful effects.

Recommendation

It should be the policy of the Government to recover and recycle all non-toxic, waterborne wastes as an alternative to present dumping into the sea. Until implementation of this policy becomes economically and technologically feasible, measures to reduce pollution should be vigorously pursued.

Sand

Puerto Rico's extraordinary economic development during the last three decades upset the dynamic equilibrium between the supply and demand for sand. Sand prices rose abruptly. Extractors turned increasingly to publicly-owned deposits, sometimes extracting illegally and other times paying the small fees--now less than 10 percent of the private market price--charged for sand extraction from public lands. Large-scale extraction operations from beaches and coastal dunes have created acute erosion problems, eliminated beaches, and also entire plant and animal communities. The problem continues to grow.

RECREATION

Puerto Rico should develop its marine recreational facilities for the enjoyment of its citizens and as an asset for attracting visitors, an important element in the Puerto Rican economy. Moreover, Puerto Rico should actively strive to make its citizens aware of the pleasure that can be derived from the sea, and particularly stress this message to those who ordinarily avoid the Island's shores.

Those who do not enjoy marine recreation include people who fear the sea, others who can not conveniently get to it because of their working hours or lack of access to the beach, and those who go to the beach but do not enjoy all it has to offer because facilities are not present.

Those who fear the water often have reason on their side. Many have simply not been taught swimming or water safety. If they have, they they are still wary because most convenient beaches do not have lifeguards. Swimmers often must worry about being cut down by fast-moving power boats.

Recommendations

1. Swimming and water safety should be introduced in all schools at all levels as part of the regular curriculum.

2. Certain areas of beach front should be restricted to swimmers.

3. The Parks and Recreation Administration should be given the responsibility for guaranteeing adequate cleaning and maintaining all beaches. In addition, and most important, the Governor should give the Administration the means to do the job, and funds should be appropriated for this purpose.

The sun sets during the summer in Puerto Rico at about 6:30 P.M. Most people who wish to go to the beaches after work must enter a constant and frustrating rush through traffic home, and then perhaps without eating, out to the beach. The effort is often not worth the reward. To get around this problem, which is not unique to Puerto Rico, many nations have established Daylight Saving Time, thereby extending their daylight hours for the recreational benefits of their citizens.

Recommendation

Daylight Saving Time linked to the Federal system should be established in Puerto Rico.

Of course an extended period of daylight would do swimmers no good if the beaches are closed. At present, our best beach facilities are closed at least one entire day during the week, chiefly on Mondays.

Recommendation

Public beaches should be kept open every day of the year.

Closing time during the summer months should be extended in direct relation to the length of daylight.

Anybody wishing to sail in Puerto Rico should be able to buy a small boat powered by wind or motor for as little as \$300. This would be far from a yacht, and would probably not be new, but at least it would be seaworthy and steerable. However, the financial ability to enjoy boating only partly depends on the cost of the equipment, especially for young sailors. Beyond the cost of the boat, low-cost, accessible shoreside facilities are also needed.

Recommendation

Because public funds are not available for projects such as marinas, public land should be leased on reasonable terms to private developers for the construction at appropriate locations of pre-designed marine recreational centers. A mechanism to implement this recommendation should be established by statute and should include environmental safeguards and others such as public hearings on lease terms and prices charged for use of facilities.

RESEARCH AND DEVELOPMENT

Puerto Rico should encourage research and development relevant to the Island's needs. The usual classification of research into "basic" and "applied" is empty here.

The Subcommittee on Research and Development has identified several areas in which there are pressing needs for research, and for gathering and making available the existing data.

Characterization of the Marine Environment

Puerto Rico uses the marine environment as a (a) habitat for marine living resources; (b) garbage dump; (c) heat dump; (d) source of sand, salt, fresh-water and chemicals; (e) medium for transportation and commerce; and (f) source of enjoyment. Obviously, many of these uses are incompatible with one another and some may be mutually exclusive. Research and data-gathering should assist in the planning and wise utilization of our marine resources toward the greatest possible benefit.

We need studies ranging from the simplest localized baseline studies to surveys including the dynamic features of our shorelines, bottomlands, and coastal waters. We do not have sufficient information regarding the constituents and dynamics of most tropical marine communities or ecosystems to allow us to speak intelligently

about their fate in the face of the environmental stresses we are imposing.

Recommendation

The Government should vigorously support a major effort to determine the dominant characteristics of our marine environment. High priority should be given to the study and description of natural marine communities.

Research in aquaculture should go beyond the mere characterization and should include specific aquacultural techniques, pilot programs, rates of harvest and processing.

There are also components of our marine biota that are harvested through capture, but are not cultured. Studies on population dynamics, possibilities of re-stocking, seasonal migration or fluctuations, and life cycles would allow for intelligent designation of capture seasons and for the protection of endangered species.

Recommendation

The Government should encourage research to characterize those components in our marine biota worthy of culture as a source of food or of pharmacologically valuable compounds.

We need to know where sands are that can be mined without harming the Island. Once we know this, we should have an evaluation of the economic feasibility of the mining operations involved and their environmental effects. Initial studies could be followed by programs directed to the development of submerged deposits, incentives, lines of credit, loans and technical aid.

Recommendation

A detailed survey of submerged sand deposits and other non-living resources in the waters of Puerto Rico should be compiled, and the technology and feasibility for their utilization assessed.

Waste Dumping

Puerto Rico is not unique in having its coastal waters used for waste disposal. We are unique, however, in that we have a wide variety of industrial wastes entering a rich tropical marine environment.

Recommendation

Research should be undertaken to determine the capacity of our coastal waters to absorb waste--industrial, thermal and domestic--and the effect these wastes have on the biota.

The possibility of large volumes of cooling water from power-plant condensers entering the sea merits not only serious study of the ecology of thermal pollution in tropical waters but also a research program to determine the alternatives.

Recommendation

The Government should support immediate research into methods of energy production that lessen the potential for stress on the Island's marine environment.

Data Bank

Developers of marine resources, scientists, and industry are often hurt because the marine data they could use either are not known to them or are stored in archives that have only very local use. As a result, we have duplication of efforts, loss of Federal money because of lack of data for proposals, inadequate long-term planning, and hindrance of development programs.

Recommendation

An Ocean Resources Information Center should be established at the Mayaguez Campus of the University of Puerto Rico.

Toward a Healthy Research Program

Funding for research on Island problems seldom comes from the insular Government. When it does, it is usually given on a project-by-project basis. Thus, the needed continuity in research is lost. Island problems that could be solved by research are considered for a while, then dropped when the Federal grant or private funds run out. Because of different mainland priorities, many Island projects are never funded or completed.

Recommendation

The Legislature should appropriate funds specifically dedicated to ocean and marine-oriented research and development, including policy research.

When a difficult problem arises that needs research, and governmental agencies are willing to allocate funds to solve it, many times the agencies look off-Island for the talent. Admittedly,

INSTITUTIONAL ARRANGEMENTS

Institutional arrangements in government are closely related to the social, economic, physical, cultural and political realities of the community, and should respond to and serve its needs. One of the greatest needs is that of elaborating a conceptual framework for institutional arrangements that takes into account the peculiarities of Puerto Rico as a system, particularly the fact that it is a small island.

The framework should also recognize that Puerto Rico is a society in transition, and consequently has tensions that are reflected in conflicting objectives and priorities. (These are discussed in detail in the Report of the Subcommittee on Institutional Arrangements.)

The importance of the policy formulation process to achieve a cohesive institutional framework is frequently unrecognized in government activities. With respect to policy formulation in the area of marine affairs, there is a critical need to stipulate goals and link these to overall economic and social objectives.

We also note:

- Many programs and activities affecting the marine environment are in conflict with one another.
- There is need to enforce all laws and regulations dealing with

marine affairs. This is one area in which citizen participation can be especially productive.

- The Government must have the necessary information and research upon which to base rational decisions.

The type of policy formulation structure that we consider most desirable for Puerto Rico in the area of marine affairs sees the Planning Board as the agency charged with translating those social priorities adopted by the Executive and Legislative branches into operational directives; in turn, these directives are transmitted to the various agencies dealing with the various sectors.

The Department of Natural Resources, which will begin operations January 1973, should be an operational department in charge of development and management of programs in marine resources, and correspondingly concerned with the enforcement of laws and regulations. It should also engage in research related to operational and development activities. In discharging these responsibilities, the Department should act in accordance with the sectoral policies established by the Environmental Quality Board.

Recommendations

1. The new Department of Natural Resources should be responsible for the execution and operation of the programs of marine

resources, and for the enforcement of laws and regulations concerned with these resources.

2. The Environmental Quality Board should be in charge of formulating policies for the marine sector. To this end, the position of Associate Director of EQB for Marine Affairs should be created.

EDUCATION AND INFORMATION

Over the past 20 years, Puerto Rico has focused on the urgent need to develop its economy, and modernize its institutions. This emphasis on consumption and industrialization has not encouraged parallel concern and awareness of the problems related to other fundamental Island values such as environmental quality and balanced growth. Government should assume a leadership role with respect to modifying values and emphasizing long-range thinking and planning. Obviously, long-range use of the marine habitat, the need to develop it and preserve it, is one large area of concern.

The Puerto Rican citizen is at present poorly aware of the cardinal truth that he lives on a small island-territory of which the sea is the hinterland. The child, however, is father of the man; and the entire educational and mass-media structures of the Island should be turned toward a program to foment this essential marine-oriented consciousness in the rising generation.

Recommendations

1. A Puerto Rican Advisory Committee should be appointed to develop--in coordination with the Department of Education--improvements in the teaching of marine affairs. New courses should be designed, new materials prepared and new training schemes for teachers proposed.
2. The Government should foment greater interaction between the school systems, colleges, adult education, industry, commerce, business, newly emerging vocational education, and the Government itself in order to develop continuing and relevant interest in marine resource matters.
3. The Government should organize contests, projects, competitive activities and youth congresses on marine matters for both Puerto Rican and other Caribbean students.

One very important problem that we face is that expertise in specific areas of marine affairs is frequently not available in Puerto Rico. The solution is not only one of creating scientists and technicians but also of generating talent necessary to formulate and carry out policy and manage marine affairs.

Recommendation

Present educational programs in the area of marine affairs should be supported and reinforced; a Masters-level program should be created in the area of environmental management with emphasis on policy analysis; undergraduate programs should be developed; and short courses and seminars for Government officials instituted.

Many trained mechanics are needed to service the small craft that berth in Puerto Rico. Some of the work is being done although there are usually long waits for engine and electrical service, and the technicians are usually not Puerto Rican.

Recommendation

Vocational schools should extend their curriculum to include training in the different nautical fields such as, but not limited to, marine electronics and marine mechanics, boat building and life saving.

One area of concern in marine affairs, characteristic of all government operations, is that information is frequently not available to interested citizens and private organizations. Further participation by citizens has also been limited to public hearings

in which the subject under discussion has already been dealt with extensively at the agency level. The result is that often the witnesses are confronted with fixed positions.

Recommendation

The Government should, by statute, establish requirements similar to those of the Federal Freedom of Information Act. Until such legislation becomes effective, agencies should establish their own Freedom of Information policies permitting release of certain classes of information without specific authorization.

As a long-range objective, meetings of Government agencies such as the Planning Board and Environmental Quality Board should be open to the public so that they may be informed about what is taking place.

Recommendations

1. The agenda of public meetings of Government agencies concerned with the environment should be made available to the public in advance of the meetings; minutes should be taken during the meetings and be made available to the public no more than one week after the meetings.

2. Government agencies should take the initiative in inviting the submission to public hearings of memoranda and points of view of all interested citizens.

ROLE OF PUERTO RICO IN THE CARIBBEAN

The Caribbean region comprises the archipelago and the coastal areas of the contiguous continental masses. The sea it encloses is a resource common to all countries on its shores. Hence, concern for its rational development, exploitation and conservation constitutes a moral obligation for all.

Puerto Rico's role within the Caribbean is conceived as one of partnership as opposed to leadership. This implies that while Puerto Rico can teach the region much, it can also learn much from the region. It also implies that since past attempts at formal regional cooperation have lapsed, they must give way to informal and functional cooperation utilizing existing Caribbean structures; and that present bilateral relationships between Puerto Rico and the United States ought to be complemented by multilateral relationships with Caribbean neighbors.

Acceptance of these imperatives and their active pursuit should help foment a new, viable international personality for Puerto Rico.

Recommendations

1. The Caribbean is a startling contrast of poor lands and rich seas. The search for new marine-oriented industries that are ecologically sound, economically feasible and socially desirable, therefore becomes urgent.

A program of studies should be initiated by the Puerto Rico Economic Development Administration and the Department of Commerce on the technical and economic feasibility of establishing new marine industries in the Caribbean community.

2. Marine science and technology is a relatively new, fast developing field. The need for Caribbean lands to share resources and talent for marine development is crucial.

A vigorous new program in marine affairs should be established within the North-South Center encouraging technical interchange and regional professional meetings.

3. The Caribbean region is increasingly one of busy inter-territorial activity. But hitherto most relationships between countries have been localized, haphazard and un-coordinated. There is a strong need for Puerto Rico's government to more fully inform itself of Caribbean activities and to more actively contribute to inter-Caribbean affairs.

An Office for Caribbean Affairs should be established within the office of the Secretary of State of the Commonwealth Government at the Assistant Secretary level.

4. The average Puerto Rican citizen is poorly informed about other Caribbean societies. Successful regional cooperation by Puerto Ricans requires the planned growth of a Caribbean consciousness.

The Commonwealth Department of Education should:

- a. further strengthen the teaching of English, a major Caribbean language, in the school system;
- b. introduce the teaching of one or two of the other major area languages; and
- c. develop and introduce textbook materials to facilitate Caribbean-oriented social studies.

5. Caribbean inter-territorial cooperation is seriously inhibited today by inadequate communications and transportation systems.

The Governor of Puerto Rico should take the initiative in convening a conference of Caribbean country representatives to consider improving regional transportation and communications.

FOR THE FUTURE

We have stressed that Puerto Rico does indeed have the resources, abilities and abundant energy to derive from its sea and shorelines many of the values it has for so long taken from its soil. The vulnerability of these environments requires that we act systematically and with care. In this report, we have tried to point out some of the ways that we believe would be profitable.

The next move is for the Puerto Rican Government to initiate an action program. A number of recommendations in this report can be implemented immediately. Others require intermediate steps, such as legislation and additional funding. To expedite action, we recommend that a Special Project Staff Unit, as described in the report of the Subcommittee on Institutional Arrangements, be set up in the Office of the Governor.

As an epilogue, we suggest that the Government support the reconvening of the Parent Committee and its Subcommittees one year after "Puerto Rico and the Sea" is received by the Governor. The aim is for the committees to reappraise their recommendations and note the actions taken. This is a novel proposal by a citizen's committee, but one that can assure continuing interest in the problems mentioned in this report as well as encourage governmental attention to them.

RESUMEN -- INFORME DEL COMITE TIMON

INTRODUCCION

Hasta hace apenas poco tiempo, los ciudadanos de Puerto Rico, en general, desconocían de las contribuciones importantes para la calidad de sus vidas que provenían de los recursos marinos. Como resultado de esto, la Isla nunca había desarrollado una ética para la custodia y administración de los recursos, ni una política pública orientada hacia la conservación o el desarrollo adecuado de los recursos del mar.

A medida que la Isla se transformaba de una economía agrícola a una predominantemente industrial, el ambiente marino se vió amenazado por nuevas presiones y demandas. Estas presiones aumentaron según la situación económica de la población mejoraba, ya que se disponía del tiempo y dinero requerido para disfrutar de la recreación marina.

El turismo aumentó rápidamente atrayendo miles de visitantes del exterior hacia las costas tropicales y los beneficios que éstas ofrecen. La expansión urbana y el desarrollo industrial se extendió hacia los estuarios, las playas y las lagunas. Los mangles y pantanos fueron drenados o rellenados con el propósito de satisfacer las demandas de una población creciente y ávida de espacio. Playas y dunas fueron destruidas en busca de arena para la construcción de

casas, fábricas, edificios de oficinas, carreteras y pistas.

Muchos ríos y aguas costaneras han sido invadidas por el sedimento que proviene de desperdicios domésticos e industriales y de alteraciones del terreno. El ambiente marino, víctima principal de este abuso, sufrió un daño progresivo cuyas ramificaciones totales todavía desconocemos.

No todo el daño ocasionado ha sido necesario ni deliberado. Los industriales y el público en general partían de la premisa que los recursos marinos se podían explotar indefinidamente. De hecho, esta premisa resulta ser cierta si los recursos se utilizan sabiamente y cuidadosamente. Esta utilización prudente es lo que estamos tratando de lograr.

Sin embargo, una Isla oceánica como Puerto Rico tiene una capacidad limitada para sobrellevar el uso intensivo y el desarrollo de sus recursos. Una vez pasado este límite -- lo cual es el estado actual de algunos de los recursos marinos de Puerto Rico -- la Isla puede transformar irreversiblemente su carácter ambiental.

Cuando anteriormente los efectos de las decisiones respecto al uso del ambiente marino eran en gran parte reversibles, a menudo ésta no es la situación en la actualidad.

El no reconocer con sobriedad la crisis de nuestro ambiente marino, surge en parte de la tendencia puertorriqueña de emular patrones de desarrollo que son más aptos para países localizados en las

masas continentales. Esta perspectiva opaca la realidad de que Puerto Rico es una pequeña isla oceánica. Por consiguiente, hay una demostrada tendencia a que las soluciones a los problemas de países en las masas continentales tienden a convertirse en las prioridades y soluciones de problemas netamente puertorriqueños.

La imperante necesidad de una utilización sabia y equilibrada de los recursos marinos de la Isla, su capacidad limitada para sostener el desarrollo intenso de sus costas, el concepto equívoco de visualizar a Puerto Rico como una masa continental -- todos estos factores nos llevan a hacer un llamamiento de acción inmediata. Con este alto grado de urgencia ofrecemos las siguientes recomendaciones para un plan de acción respecto a los asuntos marinos en Puerto Rico.

RECURSOS COSTANEROS

La zona costanera es una región compleja donde habita una gran variedad de plantas y animales marinos y terrestres. Es una región particularmente fascinante por el modo en que estas formas de vida entrelazan el mar y la tierra y dependen las unas de las otras para su supervivencia. Los mangles saludables van poco a poco creando suelo y le sirven de hogar o criadero a casi dos terceras partes de nuestras especies de fauna marina de aguas llanas. Los arrecifes y las dunas mitigan la acción de los vientos y el oleaje para proteger

las lagunas, las playas y la vegetación de las orillas. El mar en sí es la región inexplorada más grande que tiene la tierra -- una nueva frontera para el hombre en su búsqueda de recompensas recreativas, científicas e industriales.

Uso y Desarrollo del Terreno

La amenaza más peligrosa a la zona costanera de Puerto Rico es el proceso de desarrollo descontrolado a lo largo de las costas. Aunque el público sigue en la creencia que esto está ocurriendo solamente en San Juan y sus alrededores, rápidamente se están estableciendo patrones de desarrollo desparramado en casi todas nuestras áreas costaneras. Los proyectos se aprueban uno por uno, sin el beneficio de una planificación y zonificación efectiva y con escasa o ninguna participación pública. Desde hace muchos años, las agencias gubernamentales sin darse suficiente cuenta han permitido la destrucción innecesaria del máspreciado recurso de nuestra Isla, a pesar de que los medios para evitarla están disponibles. Es necesario tomar medidas inmediatamente para asegurar un balance adecuado entre las necesidades del desarrollo y las de la preservación del ambiente. Es indispensable que el público se familiarize con las operaciones que toman lugar en el proceso del desarrollo y participe de las mismas.

Recomendaciones

1. Todas las agencias gubernamentales que tratan con asuntos ambientales debieran celebrar vistas públicas, luego de los debidos avisos públicos, antes de aprobar la ubicación o el desarrollo de cualquier proyecto localizado dentro de una franja de 200 metros desde el mar.

2. El Gobernador debe asegurarse de que la Junta de Planificación publique antes de fines de 1972 y cada 6 meses después un mapa actualizado indicando el estado actual de las solicitudes para aprobación de todos los proyectos localizados a menos de 200 metros del mar.

3. El Gobernador debiera solicitar de la Junta de Planificación y de la Junta de Calidad Ambiental un plan detallado y un análisis ambiental de las tierras entre Boca de Cangrejos y el Río Loíza; también debiera asegurarle al público que ningún desarrollo se autorizará en esta área tan estratégica y amenazada hasta que estos documentos hayan sido completados y evaluados públicamente.

Políticas, Planes e Implementación

El modo de revisar proyectos uno a uno debe ser reemplazado a la mayor brevedad posible por un sistema ordenado que incluya la adopción de políticas y planes racionales, y el establecimiento de

medidas que aseguran su instrumentación. El Sub-comité de la Zona Costanera ha recomendado una serie de medidas requeridas:

Recomendaciones

1. El Gobierno debe establecer una política formal requiriendo que los desarrollos costaneros mantengan, en la medida que sea posible, el carácter natural de las costas que circundan a Puerto Rico.
2. Debieran adoptarse planes y una política pública para garantizar la protección y el desarrollo de la zona costanera. Deberán recibir atención particular medidas que aceleren los procesos de planificar y tomar decisiones, incluyendo aquellas que ayuden a los constructores y proyectistas a acelerar la planificación de áreas.
3. La Legislatura y las agencias administrativas debieran establecer un sistema de Areas de Importancia Ambiental para asegurar la protección de bahías fosforescentes, arrecifes y mangles importantes, y otras áreas de singular valor. La reglamentación, arreglos para el mantenimiento, incentivos contributivos y la compraventa de la propiedad deberán formar parte de los elementos esenciales de este sistema.
4. El Gobierno debe adquirir control sobre los escasos predios costaneros apropiados para el desarrollo de puertos, plantas de energía eléctrica e industria pesada.

5. La Legislatura debiera establecer mediante estatuto límites de densidad y de una distancia mínima entre cualquier desarrollo y el mar si las agencias apropiadas se muestran indispuestas a tomar estas medidas rápidamente.

Acceso a la Costa

Aunque el acceso público a las playas y áreas costaneras rara vez ha sido un problema en Puerto Rico, nuevos patrones de desarrollo están creando este problema para el futuro. A menos que se establezcan con prontitud, nuevos controles, más y más playas lejanas de hecho se reservarán para el uso exclusivo de los residentes de los condominios y hoteles en la costa.

Recomendaciones

1. El Gobierno debiera adoptar una política formal asegurándole a toda la población la misma oportunidad, en la práctica al igual que por ley, de disfrutar las playas y otras áreas costaneras de Puerto Rico.

2. El Gobierno debiera clarificar los derechos de propiedad existentes en la zona costanera, incluyendo la resolución de una serie de conflictos legales.

3. El Gobierno debiera establecer, ya sea por reglamento o estatuto, requisitos mínimos para el acceso a las playas, incluyendo la prohibición de la lotificación y el desarrollo de proyectos extensos en áreas que no cumplan con esos requisitos.

Energía Eléctrica

Si no se desarrollan nuevos métodos para producir electricidad, las plantas para la producción de energía eléctrica seguirán concentrándose en la zona costanera. Ningún tipo de planificación para el uso del terreno podrá proteger nuestros recursos costaneros si las tendencias actuales respecto al consumo de energía continúan indefinidamente. Ha llegado la hora de preguntarnos cómo se puede controlar este aumento acelerado y a la vez satisfacer efectivamente las demandas legítimas.

Recomendación

El Gobierno debiera desarrollar durante los próximos cinco años una política pública coherente y realista para la producción y el consumo de energía eléctrica.

Protección de Recursos

Una combinación de factores, todos surgiendo a la larga como resultado de una falta de conciencia respecto a la importancia de los procesos naturales, están gradualmente eliminando los criaderos de la vida marina.

Arrecifes y Manglares

Los arrecifes y manglares, productores eficientes de la vida marina, se encuentran particularmente amenazados. Para eliminar algunas de las presiones amenazadoras y tratar de recuperar las características estables de su ambiente, el Sub-comité de Recursos Vivientes ha identificado una serie de medidas necesarias.

Recomendaciones

1. Es necesario crear un sistema de Santuarios Marinos Públicos, cuidadosamente coordinados con un sistema similar de Areas de Importancia Ambiental.
2. Debe prohibirse la extracción, transportación, posesión o venta de coral de cualquier arrecife en aguas de Puerto Rico.
3. Debe prohibirse la pesca con fiqas y fomentarse la fotografía submarina.

4. Todos los manglares que son propiedad pública deben transferirse a la custodia del nuevo Departamento de Recursos Naturales para formar parte del Sistema Forestal Insular.

5. Debe declararse un moratorio de 1 año respecto al desarrollo de cualquier manglar que sea propiedad privada, para proveerle al Departamento de Recursos Naturales un período para efectuar un inventario y una evaluación de estas áreas y recomendar la adquisición pública de ciertos manglares.

Pesca Comercial

La escasez de peces en la costa, la falta de conocimientos sobre los recursos del mar afuera, la falta de equipo y técnicas modernas, las embarcaciones obsoletas y los programas de crédito poco realistas, contribuyen a perpetuar el estado crítico actual de la pesca comercial en Puerto Rico. Nuestros 3,000 pescadores ganan escasamente un promedio de \$1,600 al año. Sin embargo, estudios recientes indican que la producción de pesca se podría triplicar, con un aumento correspondiente en los ingresos de los pescadores.

Recomendaciones

1. El Gobierno debiera crear un sistema de crédito realista para los pescadores.

2. El Gobierno debiera establecer un programa de entrenamiento en navegación, mantenimiento de equipo y administración de pequeños negocios.

Pesca Deportiva

El uso intensivo de las aguas costaneras ha puesto en peligro la pesca deportiva en Puerto Rico. Se necesita ayuda gubernamental para remediar esta situación, sobretodo si los ciudadanos y los turistas han de continuar disfrutando de la pesca deportiva en nuestras aguas.

Recomendaciones

1. Debe establecerse un programa para localizar, inventariar y demarcar todas las áreas de pesca conocidas y potenciales donde la pesca deportiva pueda concentrarse inicialmente y desarrollarse mejor.

2. Todas las leyes y reglamentos vigentes relacionados a la pesca deportiva deben evaluarse; las recomendaciones al respecto deben someterse a la Legislatura para que se establezca un nuevo código de leyes uniformes y actualizadas con provisiones para ponerlas en vigor.

Calidad del Agua

La degradación de la calidad del agua es una de las maneras más insidiosas de destruir la vida marina en la zona costanera. El desechar desperdicios en las aguas costaneras, al igual que otras prácticas más indirectas (como por ejemplo, los movimientos de terrenos o el uso de abonos) pueden tener efectos nocivos sobre la calidad del agua.

Recomendación

El Gobierno debiera adoptar la política de recuperar y re-utilizar todos los desperdicios líquidos no-tóxicos como una alternativa al actual sistema de desechar desperdicios al mar. Hasta que la implantación de esta política sea económica y tecnológicamente factible, ciertas medidas para reducir la contaminación se debieran aplicar vigorosamente.

Arena

El extraordinario desarrollo económico registrado en Puerto Rico durante las últimas tres décadas ha trastornado el equilibrio dinámico entre la oferta y la demanda de arena. El precio de la arena aumentó rápidamente. Los extractores empezaron a suplirse

de los depósitos públicos, extrayendo arena ilícitamente o pagando la pequeña suma -- actualmente menos del 10 por ciento del precio de arena en el mercado -- cobrada por la extracción de arena de terrenos públicos. La extracción en gran escala de las playas y dunas costaneras ha creado graves problemas de erosión y ha eliminado playas y comunidades enteras de plantas y animales. Este problema continúa aumentando.

Recomendaciones

1. La extracción de arena de áreas públicas para propósitos comerciales debe prohibirse, y debe exigirse la preservación de todas las dunas existentes.
2. Los reglamentos administrativos vigentes deben enmendarse para asegurar que los precios cobrados por la extracción comercial de arena de depósitos públicos equivalgan a los precios del mercado privado.

Naufragios

Se sabe que los restos de más de 100 naufragios yacen en las aguas alrededor de Puerto Rico. Algunos de éstos forman parte de nuestro patrimonio. Sin protección legal, sin embargo, éstos pronto desaparecerán. Algunos ya han desaparecido.

Recomendación

El Gobierno debiera designar los restos de naufragios en aguas de Puerto Rico como reliquias nacionales y prohibir la alteración o rescate de las mismas sin previa autorización.

RECREACION

Puerto Rico debiera desarrollar sus facilidades recreativas para el disfrute de sus ciudadanos, y para atraer visitantes -- una consideración importante para nuestra economía. Además, Puerto Rico debiera tratar de despertar en sus ciudadanos un amor hacia los placeres que pueden derivarse del mar, y en particular, llevar este mensaje a aquellos que generalmente evitan el disfrute de nuestras playas.

Los que no disfrutan plenamente de la recreación marina incluyen aquellos que le temen al mar, aquellos para quienes las playas no están a su alcance -- ya sea por falta de tiempo o por barreras físicas -- y aquellos que van a las playas pero que no las disfrutan plenamente porque no hay facilidades adecuadas.

Los que le temen al mar frecuentemente tienen razón para sus temores. Muchos no saben nadar, y los que saben, evitan algunas playas convenientes porque no están debidamente vigiladas por

salvavidas. Aún cuando saben nadar y hay salvavidas, existe la posibilidad de accidentes debido al uso de botes de motor muy cerca de las orillas de las playas.

Recomendaciones

1. La natación y las reglas de seguridad en el agua debieran introducirse al currículo regular en todas las escuelas y en todos los niveles.
2. Algunas áreas cerca de las orillas debieran reservarse para el uso exclusivo de los bañistas.
3. La Administración de Parques y Recreos Públicos debiera tener la responsabilidad de garantizar la limpieza y mantenimiento adecuado de todas las playas. Además el Gobernador debiera asegurarse que a dicha Administración se le proporcionen los medios para realizar esta encomienda y se le provean fondos para ese fin.

Durante el verano, el sol en Puerto Rico se pone alrededor de las 6:30 P.M. Muchas personas que desean ir a la playa después del trabajo tienen que perder su tiempo en el tráfico y quizás posponer la hora de comida, para poder ir a la playa. El disfrute tan breve a veces no compensa el esfuerzo. Para resolver este problema, que no ocurre únicamente en Puerto Rico, muchos países han establecido

el sistema "Daylight Saving Time" extendiendo así las horas de luz solar para el beneficio recreativo de sus ciudadanos.

Recomendación

Puerto Rico debiera adelantar el horario instituyendo el sistema de economizar luz solar conocido por "Daylight Saving Time"; éste debiera coordinarse con el sistema Federal.

Por supuesto, extendiendo el período de luz solar no beneficiará a los bañistas si las facilidades de las playas están cerradas. En la actualidad, nuestros mejores balnearios permanecen cerrados por lo menos un día por semana, generalmente los lunes.

Recomendación

Todos los balnearios públicos debieran permanecer abiertos todos los días del año. Durante los meses de verano, la hora del cierre debiera extenderse en relación directa a las horas de luz solar.

El que desee navegar en Puerto Rico y quiera comprarse un bote pequeño de vela o de motor, podría hacerlo pagando cerca de \$300. Este distaría mucho de ser un yate, pero por lo menos sería seguro y manejable. Todavía no se ha probado que haya una relación estrecha

entre el placer de la navegación y el costo del equipo utilizado, particularmente para los marineros jóvenes. Además del costo del bote sin embargo, se necesitan algunas facilidades náuticas.

Recomendación

Debido a que no hay fondos públicos disponibles para proyectos como marinas, ciertos terrenos públicos debieran arrendarse bajo términos razonables a proyectistas privados para la construcción de centros de recreación marina pre-diseñados en lugares apropiados. El mecanismo para implementar esta recomendación deberá establecerse mediante estatuto, y deberá incluir medidas para la protección del ambiente, tales como vistas públicas para las condiciones del arrendamiento y los precios a cobrarse por el uso de las facilidades.

INVESTIGACION Y DESARROLLO

Puerto Rico debe estimular la investigación y desarrollo relevante a las necesidades de la Isla. La clasificación corriente de la investigación en términos de básica y aplicada no tiene gran significado aquí.

El Sub-comité de Investigación y Desarrollo ha identificado varias áreas donde procede urgentemente que se haga investigación, y se recopile y haga disponible la información existente.

Caracterización del Ambiente Marino

Puerto Rico utiliza el ambiente marino como repositorio de (a) recursos marinos vivientes; (b) vertedero de basura; (c) vertedero de desperdicios termales; (d) fuente de arena, sal, agua y productos químicos; (e) medio de transportación y comercio y (f) lugar de recreo. Obviamente, muchos de estos usos son incompatibles entre sí, y podrían hasta excluirse mutuamente. La investigación y la recopilación de datos debe ayudar en la planificación y utilización prudente de nuestros recursos marinos para obtener el mayor beneficio posible.

Necesitamos hacer investigaciones que cubran desde los más sencillos estudios de base hasta aquellos que incluyan los aspectos dinámicos de nuestras costas, fondo del mar y aguas costaneras. No tenemos suficiente información acerca de los componentes y la dinámica de los sistemas ecológicos o comunidades marinas tropicales para que podamos hablar inteligentemente de como han de reaccionar estas comunidades ante la carga ambiental que les estamos imponiendo.

Recomendación

El Gobierno debiera apoyar vigorosamente un esfuerzo mayor para determinar las características sobresalientes de nuestro ambiente marino. Se le debe dar alta prioridad al estudio y descripción de las comunidades marinas naturales.

La investigación en el campo de la acuicultura deberá ir más allá de la mera caracterización y deberá incluir técnicas de acuicultura específicas, proyectos pilotos, ritmo de producción, y procesamiento.

También hay algunos componentes de la biota marina que son capturados en vez de cultivados. Estudios sobre la dinámica poblacional -- la posibilidad de reponer las especies, las migraciones o fluctuaciones estacionales, y los ciclos de vida -- permitirían la designación inteligente de estaciones de pesca o captura y la protección de las especies amenazadas.

Recomendación

El Gobierno debiera fomentar la investigación para identificar aquellos componentes de las comunidades marinas que merezcan cultivarse como fuente de alimento o de valiosos compuestos farmacológicos.

Es preciso saber de dónde podemos extraer arena sin ocasionarle daños a la Isla. Una vez sepamos esto, debemos hacer una evaluación de la viabilidad económica de las operaciones de extracción envueltas y sus efectos sobre el ambiente. Los estudios iniciales podrían conducir a programas dirigidos hacia el desarrollo de los depósitos sumergidos, la creación de incentivos, fuentes de crédito, préstamos y ayuda técnica.

Recomendación

Debe recopilarse un inventario detallado de los depósitos de arena sumergida y otros recursos minerales en las aguas de Puerto Rico, y evaluarse la tecnología y viabilidad de la utilización de los mismos.

Descargas al Mar

Puerto Rico no es el único lugar en el mundo donde se desechan los desperdicios en las aguas costaneras. Sí somos únicos, sin embargo, en que tenemos una gran variedad de desperdicios industriales que se están introduciendo a nuestro fértil ambiente marino tropical.

la información utilizable sobre asuntos marinos. Por lo tanto existe la duplicación de esfuerzos, la pedida de fondos Federales ocasionada por falta de datos para elaborar propuestas, y una mala planificación que obstaculiza el establecimiento de programas de desarrollo.

Recomendación

Debe establecerse un Centro de Información sobre Recursos Marinos en el recinto de Mayaguez de la Universidad de Puerto Rico.

Hacia un Programa Saludable de Investigación

Los fondos para investigación sobre problemas de Puerto Rico nunca provienen del Gobierno Insular. Cuando se otorgan, se hace únicamente para proyectos aislados. De esta manera, se pierde la continuidad requerida en la investigación. Los problemas de la Isla que podrían resolverse mediante la investigación, se consideran por un tiempo y luego se abandonan cuando se acaban los fondos federales o privados. Debido a que las prioridades en los Estados Unidos tienden a ser diferentes a las nuestras, muchos proyectos de la Isla no reciben fondos o no llegan a completarse.

Recomendación

La Legislatura debiera asignar fondos destinados específicamente para la investigación y el desarrollo orientados hacia el mar y los asuntos marinos, incluyendo la investigación necesaria para poder formular una política pública en este campo.

Frecuentemente, cuando surge un problema difícil que requiere investigación y hay agencias gubernamentales con fondos disponibles para este propósito, la tendencia inicial es la de buscar el talento requerido fuera de la Isla. Hay que reconocer que Puerto Rico carece de ciertos talentos técnicos y que es necesario obtenerlos del exterior. Sin embargo, los expertos necesarios deberían solicitarse primero en la Isla, de manera que se estimule el desarrollo del talento local. Las agencias gubernamentales debieran tratar de que cuando se utilicen expertos del exterior, éstos trabajen de cerca con el personal local para entrenarlo mejor en las materias de su competencia.

Recomendaciones

1. El Gobernador debiera enviarle una declaración de política pública a todas las agencias de gobierno al efecto de que se le dé preferencia a las facilidades y al talento local para trabajos de

investigación.

2. Los expertos del exterior que vienen temporariamente a Puerto Rico debieran trabajar muy de cerca con el personal local para entrenarlo en las materias de su competencia.

ARREGLOS INSTITUCIONALES

Los Arreglos Institucionales en el Gobierno están estrechamente relacionados con las realidades socio-económicas, físicas, culturales y políticas de la comunidad, y deben de servir y responder a las necesidades de ésta. Una de las necesidades más apremiantes es la de desarrollar un esquema conceptual de los arreglos institucionales que tome en consideración las peculiaridades de Puerto Rico como sistema, particularmente el hecho de que es una isla pequeña.

Este esquema también deberá reconocer que Puerto Rico es una sociedad en transición, y como tal, sufre una serie de tensiones que se reflejan en prioridades y objetivos conflictivos. (Esto se discute más detalladamente en el Informe del Sub-comité de Arreglos Institucionales.)

La importancia del proceso de formular políticas para lograr una estructura institucional consistente no se reconoce en la actualidad gubernamental. Con relación a la formulación de política

en el área de asuntos marinos, hay una necesidad crítica de estipular metas y de integrarlas a los objetivos sociales y económicos generales.

También cabe notar que:

- Muchos de los programas y actividades que afectan el ambiente marino confligen entre sí.
- Es necesario poner en vigor todas las leyes y reglamentos que breguen con asuntos marinos. En esta área la participación ciudadana podría jugar un papel importante.
- Para tomar decisiones racionales el Gobierno debe tener la información necesaria basada en la investigación.

El tipo de estructura para la formulación de política pública en el área de asuntos marinos que creemos más deseable para Puerto Rico le asigna a la Junta de Planificación la tarea de convertir en directrices operacionales las prioridades sociales adoptadas por la rama Ejecutiva y la Legislativa. A su vez, estas directrices pasarían a las distintas agencias que bregan con los diversos sectores.

El Departamento de Recursos Naturales, que empezará a operar en enero de 1973, deberá ser el departamento operacional encargado de desarrollar y administrar los distintos programas en el área de recursos marinos. También a éste le corresponderá velar por el cumplimiento de las leyes y reglamentos, y conducir investigaciones relacionadas a las actividades operacionales y de desarrollo. Para llevar a cabo estas responsabilidades, el Departamento deberá seguir las políticas sectoriales establecidas por la Junta de Calidad Ambiental.

Recomendaciones

1. El nuevo Departamento de Recursos Naturales debiera estar a cargo de la ejecución y operación de programas en el área de recursos marinos, y debiera velar por el cumplimiento de las leyes y reglamentos que atañen a estos recursos.

2. La Junta de Calidad Ambiental debiera estar a cargo de la formulación de la política pública del sector marino. Para realizar este propósito, debiera crearse dentro de dicha junta el puesto de Director Asociado para Asuntos Marinos.

EDUCACION E INFORMACION

Durante los últimos veinte años, Puerto Rico ha canalizado sus esfuerzos hacia la urgente necesidad de desarrollar su economía y modernizar sus instituciones. El énfasis en el consumo y la industrialización no ha fomentado una similar preocupación o conciencia de los problemas relacionados con otros valores isleños fundamentales tales como la calidad ambiental y el desarrollo equilibrado. El Gobierno debiera asumir un rol de liderato para modificar los valores existentes y darle énfasis a conceptualizar y planificar a largo plazo. Obviamente, la necesidad de utilizar, desarrollar y conservar el ambiente marino para el futuro es una preocupación importantísima.

El ciudadano puertorriqueño de hoy está escasamente conciente de una verdad fundamental: de que vive en un pequeño territorio isleño donde el mar es el traspais. El niño de hoy será el hombre del mañana; por ésta razón es necesario que todas las estructuras educativas y de comunicación en la Isla se pongan al servicio de un programa orientado hacia estimular una mayor conciencia de los asuntos marinos entre las nuevas generaciones.

Recomendaciones

1. Debe designarse un Comité Asesor Puertorriqueño que trabaje con el Departamento de Instrucción Pública hacia mejorar la enseñanza de asuntos marinos. Es necesario diseñar nuevos cursos, preparar nuevos materiales y proponer nuevos métodos para entrenar a los maestros.
2. El Gobierno debiera fomentar una mayor interacción entre las escuelas, las universidades, la educación continuada, la industria, el comercio, y la nueva instrucción vocacional de manera que se desarrolle un interés oportuno y continuo respecto a los recursos marinos.
3. El Gobierno debiera organizar concursos, proyectos, competencias y congresos de asuntos marinos para los estudiantes de Puerto Rico y de otros países del Caribe.

Un problema muy importante con el cual nos confrontamos es que en Puerto Rico con frecuencia no hay expertos disponibles en áreas específicas de asuntos marinos. La solución no es únicamente la de crear científicos y técnicos, sino también la de producir el

talento necesario para formular e implementar política pública, y desarrollar el talento gerencial en el campo de asuntos marinos.

Recomendación

Los programas educativos actuales en el área de asuntos marinos debieran apoyarse y fortalecerse. Se debe establecer un programa de gerencia ambiental, a nivel de maestría, que le dé particular importancia al análisis de políticas. También es necesario crear programas al nivel de bachillerato, y establecer cursos y seminarios cortos para funcionarios públicos.

Se necesitan mecánicos diestros para darle servicios a las embarcaciones pequeñas que se fondean en Puerto Rico. Parte del trabajo que generan éstas embarcaciones se está realizando actualmente, pero hay esperas extremadamente largas para servicios de electricidad y mecánica de motores, y por lo general los técnicos no son puertorriqueños.

Recomendación

Las escuelas vocacionales debieran extender su currículo para incluir entrenamiento en las diversas ramas de técnica náutica,

tales como electrónica y mecánica marina, construcción de embarcaciones, reglas de salvamento, y otras.

Existe un motivo en el campo de los asuntos marinos que caracteriza a todas las operaciones gubernamentales. Se trata del hecho de que las organizaciones privadas y los ciudadanos interesados, con frecuencia no tienen acceso al caudal de información disponible.

Además, la participación de la ciudadanía se ha limitado a las vistas públicas, luego de que el tema de la vista ha sido discutido ampliamente dentro de las respectivas agencias. El resultado es que a menudo estas vistas sirven para legitimar las decisiones ya tomadas.

Recomendación

El Gobierno debiera establecer mediante estatuto disposiciones similares a las establecidas en la Ley de Libertad de Información Federal. En lo que esta legislación se pone en vigor, las agencias deben establecer sus propias políticas de Libertad de Información permitiendo la liberación de cierta clase de información sin autorización específica al efecto.

Como un objetivo a largo plazo, las reuniones de las agencias del Gobierno, tales como la Junta de Planificación y la Junta de Calidad Ambiental, deberán abrirse al público para que la ciudadanía esté informada de lo que está ocurriendo.

Recomendaciones

1. Las agencias gubernamentales cuya responsabilidad es bregar con problemas ambientales debieran proveerle al público con bastante antelación la agenda de las reuniones públicas a celebrarse. Las minutas tomadas durante las reuniones debieran estar disponibles para el público dentro de un período después de las reuniones.
2. Las agencias gubernamentales debieran tomar la iniciativa de invitar a los ciudadanos a las vistas públicas para que estos sometan sus memorandos y puntos de vista.

EL ROL DE PUERTO RICO EN EL CARIBE

La región del mar Caribe incluye su archipiélago y el litoral de las masas continentales circundantes. El mar incluido en este territorio es un recurso común que comparten todos los países de la región. Por lo tanto, la preocupación por el desarrollo racional, la explotación y la conservación de este recurso constituye una obligación moral para todos.

El rol de Puerto Rico en el Caribe se visualiza más bien en terminos de colaboración y no de liderato. Esto implica que aunque Puerto Rico tiene mucho que enseñarle a la región, también puede aprender mucho de ésta. Implica además que ya que los esfuerzos previos hacia una colaboración formal entre los países de la región han decaído, estos esfuerzos deberán cederle paso a los intentos para lograr una colaboración informal y funcional utilizando las estructuras existentes del Caribe. Esta visión también conlleva el que la relación bilateral entre Puerto Rico y los Estados Unidos se complemente con una serie de relaciones multilaterales con las islas del Caribe.

Sin duda, la aceptación y la persecución de estos imperativos ayudará a fomentar la creación de una nueva y viable personalidad internacional para Puerto Rico.

Recomendaciones

1. En el area del Caribe hay un marcado contraste de tierras pobres y mares ricos. Es urgente buscar nuevas industrias con orientación marítima que sean ecológicamente prudentes, económicamente factibles, y socialmente deseables.

La Administración de Fomento Económico y el Departamento de Comercio de Puerto Rico debieran iniciar un programa de estudios

sobre la viabilidad económica y técnica de establecer nuevas industrias marinas en el Caribe.

2. La tecnología y ciencia marina es un campo relativamente nuevo y en constante crecimiento. La necesidad de que los países del Caribe compartan recursos y talento para fomentar el desarrollo marino resulta ser crucial.

Se debiera establecer en el Centro Norte-Sur un programa nuevo y vigoroso que esté dedicado a estimular el intercambio técnico y a la celebración de reuniones para los profesionales de la región.

3. La región del Caribe es cada vez más un área de actividad inter-territorial. Sin embargo, hasta ahora casi todas las relaciones entre países han sido localizadas, fragmentadas y mal coordinadas. Es muy necesario que el Gobierno de Puerto Rico esté mejor informado de las actividades del Caribe y participe activamente en los asuntos de la región.

Debe establecerse una Oficina para Asuntos del Caribe dentro de la Secretaría de Estado de Puerto Rico al nivel de Secretario Auxiliar.

4. El ciudadano promedio de Puerto Rico no está debidamente informado acerca de las demás sociedades del Caribe. El éxito de las contribuciones puertorriqueñas a la cooperación regional

requiere desarrollar internacionalmente la conciencia de que Puerto Rico pertenece al Caribe.

El Departamento de Instrucción Pública debiera:

- a. fortalecer aún más la enseñanza del inglés, un importante idioma del Caribe, en el sistema escolar;
- b. introducir la enseñanza de uno o dos de los otros idiomas importantes del área; y
- c. desarrollar e introducir libros de texto que faciliten los estudios sociales orientados hacia el Caribe.

5. La cooperación entre los distintos países del Caribe se ve seriamente obstaculizada por los actuales sistemas inadecuados de comunicación y transportación.

El Gobernador de Puerto Rico debiera tomar la iniciativa de convocar una conferencia de representantes de los distintos países del Caribe para deliberar sobre como mejorar los sistemas regionales de comunicación y transportación.

PARA EL FUTURO

Hemos recalcado que Puerto Rico de hecho cuenta con los recursos, las habilidades y la energía abundante para derivar del mar muchos de los bienes que tradicionalmente se han obtenido del suelo. La vulnerabilidad de los ambientes marinos requiere que actuemos sistemáticamente y con cuidado. En este informe hemos tratado de indicar algunas de las maneras de actuar que creemos serían ventajosas.

El próximo paso es que el Gobierno de Puerto Rico inicie un programa de acción. Muchas de las recomendaciones en este informe pueden instrumentarse inmediatamente. Otras requieren que se tomen medidas intermedias, tales como instituir legislación y conseguir fondos adicionales. Para acelerar la acción, recomendamos que se establezca dentro de la Oficina del Gobernador una Unidad Especial de Proyecto, como se describe en el Informe del Sub-comité de Arreglos Institucionales.

Como epílogo, sugerimos que el Gobierno vuelva a convocar el Comité Timón y los Sub-comités un año luego de entregársele al Gobernador el informe "Puerto Rico y el Mar". Así los comités podrían revisar sus recomendaciones y las acciones tomadas al respecto. Esta es una propuesta innovadora por parte de un comité de ciudadanos, pero una que puede proveerle continuidad al interés

por los problemas expuestos en el informe, y estimular al Gobierno a prestarle atención a éstos.

SECTION 1 -- REPORT OF SUBCOMMITTEE
ON LIVING RESOURCES

INTRODUCTION

The Living Resources Subcommittee considered its scope of concern to include all living resources within the zone of marine influence, that is, from the 100-fathom contour stretching inland to coastal wetlands, whether fresh or salt; and also the offshore islands, each of which is a special product of marine forces. Within these areas of land and sea, we recognize a number of distinct habitats for living things, including fresh water, brackish, and salt marshes; dunes, beaches, rocky shores, lagoons, estuaries, mangroves, reefs, the sea bottom and the sea itself.

The marine community is a complex web of intricately related habitats. Each habitat helps support its distinctive living resources. The various kinds of habitats are linked together by the marine organisms, many of which during their life cycles depend upon more than one habitat for survival.

Northern latitude natural communities are under constant but unstable environmental stress. Characterized by relatively few species and large populations, the communities are able to adapt to drastic cyclic environmental changes, and make rather quick

adjustments to new environmental atresses. Tropical communities are less able to cope with environmental instability. As a result of the stable environmental conditions under which tropical communities evolved, the relationship between their species components is very complex and very specialized, but the relationship between the species and the environment is direct and simple. Consequently, tropical marine communities are very susceptible to environmental change. Damage or destruction of one marine community or habitat is quickly felt and reacted to by many of the others.

Measurable losses in seascapes and landscapes have occurred. Reef systems have been pilfered for coral and tropical fish. Pristine beaches and dunes which were once sought after for pleasure no longer exist. Marine life forms such as the green turtle and the Manati are rare and endangered because of overfishing and habitat destruction. Once thriving reefs are dying or dead because of sedimentation, turbid water and other forms of pollution.

The marine resources, which Puerto Rico once took for granted, are now finally creating attention. A more affluent society, while slowly contaminating or eliminating marine environments, has nevertheless become accustomed to the sea as a source of food and

pleasure. The community now looks to the sea with a different point of view: the quality of life is greatly enhanced by careful nurture of the sea and its resources, both living and non-living. It has become the task of the community at large to reappraise public policy, to create new mechanisms and systems to protect and manage the marine resources, and to look for innovative ways to develop them for the benefit of the community.

PROTECTION OF LIVING RESOURCES

The living resources of the tropical marine ecosystems are dispersed through a series of communities, each highly diversified in their species composition, highly specialized and highly dependent upon each other. These tropical marine communities exert important and diversified influence upon the land systems, especially island land systems. This influence is in inverse relationship with an island's size. Some small islands are formed of 100 percent biogenic calcareous marine sediments. Puerto Rico has 380 miles of coastline over a total 3,400 square miles. The magotes and the northern coastal plains are largely coralline deposits, and many of the natural beaches are formed by protective coral-reef barriers. If the coral reefs protecting the beaches were to disappear, the calm waters of Luquillo Beach, for example,

and the deposited sands would be lost.

The value of our marine living resources extends beyond their influence upon our coastal geomorphology. Marine communities are also productive areas for commercial and sport fishing, educational, recreational and touristic endeavors. All too often land planners fail to consider the impact of their developments and land-use schemes upon fresh, brackish and salt-water marine systems. Marine resource users, such as commercial and sport fishermen and recreationists, compete for, overuse and deplete some of the components of the marine environment to the overall detriment of the system. The net result is the slow elimination of marine habitats, which science is beginning to prove are essential to the well-being and survival of man himself.

Coral Reefs and Mangrove Areas

Of the marine living systems of Puerto Rico, the most critical in terms of their role to the entire neritic habitat are the coral reefs and the mangrove estuaries. These are also the most critical in terms of their current rate of destruction.

Reefs

Coral reefs are among the most biologically productive, diverse, and aesthetically unique communities on earth. They also comprise

the most extensive shallow-water habitats. Puerto Rico's reef community fringes about 75 miles (20 percent) of our coastline.

Because the reefs are submerged, we do not readily see and become concerned about the effects of man's activities upon them as easily as we see his effects upon a forested habitat cut and flattened for urbanization. Puerto Rico's coral reefs are seriously threatened by a variety of man's activities, namely, sedimentation from poor land use and dredging, sewage pollution, oil and thermal pollution from industries and coral extraction.

When a reef community is destroyed, the ecological conditions become such that it cannot be taken for granted that the reef community will ever replace itself. Surveys and studies have shown that 30 years after the destruction of a reef, there was no sign of regeneration. A reef cannot sustain itself without the presence of the coral polyp. This living organism creates an environment favorable to myriad kinds of animals. If the corals are killed, the other organisms migrate or die. The entire system eventually disappears.

Reefs serve mankind in many important ways. They provide a buffer against seas pounding shorelines. Consequently, they moderate currents and also influence the deposition of sand essential to the formation and maintenance of beaches. Shoreline has been known to

recede inland by as much as two kilometers resulting from reef destruction. The progressive degeneration of the reefs off the Isla Verde coastline is directly attributable to the dredging of the Boca de Cangrejos channel and the escape of lagoon sediments that created the musky waters that coral cannot tolerate.

Reefs shelter and support the majority of fishes and crustaceans that are commercially extracted from our coastal waters, most importantly snappers, groupers, parrot fishes, grunts, lobsters and mollusks.

The recreational values of coral reefs are well known and growing; they provide for fishing, diving and unusual scenic appreciations. Scientific and educational values are high: little is really known and understood about how reefs form, the ecological succession of the reef community, rates of coral growth, food chains, and physiological tolerances to various disturbances.

Recommendations

1. Legislation should be established to create a system of publicly-owned marine environmental sanctuaries. (A proposal for legislation to accomplish this recommendation is appended as Legislative Proposal No. 1.)

2. Legislation should be established to prohibit the removal, transport, possession and/or sale of coral from any reef fringing Puerto Rico's shoreline, and the importation of coral from elsewhere for sale or resale in Puerto Rico. (A proposal for legislation to accomplish this recommendation is appended as Legislative Proposal No. 2.) [See also similar recommendation of Subcommittee on Coastal Zone Management on the protection of coral.]

Mangroves

The pioneer vegetation of shores with quiet salt water is a swamp forest known as a mangrove. Generally, mangroves are identified as an ecological unit rather than a species. Four major types of mangroves have been identified in Puerto Rico, the most important of which is the species Rhizophora or red mangrove. These mangroves basically have similar characteristics in that specialized root systems are established, which form an interwinding mass beneath the surface of the water. The seeds germinate and become viable when detached and fall from their parent, and may become anchorage as they drift in the water.

Mangroves have several long-term and short-range beneficial characteristics. They are efficient builders of land. Their root system retards and stabilizes the movement of the water, and because of this, suspended sediment is deposited among the trees, gradually

raising the land level. Because of the calmness of the water, the sediment deposited is silt and clay rather than coarser sand. The organic material deposited by the mangrove together with these mineral deposits produce a rich organic soil. As soil is accumulated, the mangroves march steadily seaward into new waters. A second characteristic of the mangrove is that the combination of large amounts of organic matter and the extensive root system form a rich, protected substrate in which a large variety of organisms live. These organisms serve as a food base for marine fauna and flora, some of which, such as oysters and crabs, are directly harvestable. Some fish of commercial importance, such as snapper, are found living under the canopy formed by the mangrove roots, while others spend part of their life cycle there for breeding and spawning. Nearly two-thirds of salt-water fish life is directly or indirectly dependent on mangrove areas for its survival. The fish either spawn or live in mangrove areas; or eat organisms, part of whose life cycle is spent in mangrove areas.

Mangrove areas form part of the nesting habitat for native and migratory bird species. Some of these water fowl are hunted as game birds while others, such as the Cattle Egret, are largely responsible for eradication of a serious tick problem among dairy cattle.

Recreational and touristic values can be associated with these lands, but at present little or no use has been made of this potential. Finally, mangroves are valuable as objects of scientific and ecological study.

The only study that has been made describing the mangrove communities in Puerto Rico was done by Heatwale. According to his 1960-survey of topographic maps, the total area occupied by mangrove swamps was 16,600 acres. Other studies had determined that mangrove swamps deposit several unique types of soil. Consequently, whenever any of these soils occur, it is known that at one time that area was covered with mangrove. The maximum extent of estuarine soils was 65,000 acres. By mid 1960's the total estuarine areas were only two-thirds as large, or 41,400 acres of which 18,200 were in open water and 23,100 were land. Of the land area, only 16,600 acres were in mangrove, representing a deforestation of 6,500 acres or 28 percent. About half of the mangrove areas left today are now in public ownership. Nevertheless, all are seriously threatened.

Deforestation did not occur uniformly over the entire island: some zones show a complete loss of mangrove, others virtually none. Neither the casual factors resulting in this loss nor the time it occurred is known.

The destruction of mangroves between the mid 1960's and 1970's has been great. However, assessment must depend upon ground surveys of particular areas. Many of those that were sampled show extensive destruction. In some instances, draining has been deliberate to provide additional areas for agriculture and building. Other instances have resulted from ignorance or careless disregard. For example, the Boquerón mangrove has been 88 percent destroyed owed to effects of road construction, which modified drainage patterns. Sand removal and the concomitant influence upon drainage patterns have also caused some destruction.

Recommendations

1. All existing publicly-owned mangrove areas not included in the proposed Marine Environmental Sanctuaries should be immediately consolidated into one government agency and be made part of the Commonwealth Forest System. An immediate one-year moratorium should be declared on the development of all other existing mangrove areas, presumably all privately-owned and comprising about 7,400 acres. During the one-year moratorium the newly-created Department of Natural Resources should inventory and study these areas and submit its recommendations in legislative form for the public acquisition of all or part of the privately-owned mangrove areas.

2. The Department of Natural Resources should take steps to derive and implement management plans for the publicly-owned mangrove areas to guarantee harmonious use: the various uses for the mangroves should supplement each other as much as possible, but interfere with each other as little as possible.

3. An environmental ethic and public policy should establish that the existing environmental quality of any of the reefs and mangrove areas will not be degraded by works of man which may be established outside of the reefs and mangrove systems.

AQUACULTURE RESEARCH, DEVELOPMENT AND TRAINING

Although the fisheries of Puerto Rico have received increased attention in the past decade, most of the efforts have been oriented toward the hunt and search operations that fishing in natural waters entails. Only cursory attention has been given and little energy spent on the investigation and exploitation of the aquacultural resources of the country. The success obtained by aquacultural endeavors in other nations, at times even under the most primitive levels of management and techniques and under most difficult conditions, supports the belief that the future contributions to the fisheries of Puerto Rico from aquaculture could be highly significant.

Aquaculture in Puerto Rico deserves much more attention than it is now receiving. The inland, estuarine and coastal areas and the remaining area that comprises the insular shelf surrounding Puerto Rico offer a large potential for tapping aquacultural resources, both at the subsistence and commercial-industrial levels.

Aquatic Life

Tropical marine communities are characterized by many different kinds of fish but relatively few of each kind. Fish catches in traps or by sieving result therefore in capturing few commercially valuable fish. These are sold, of course, but the non-commercial or "trash fish" are thrown away. This procedure constitutes a substantial drain on the fisheries' productivity. Many of the wasted specimens are not consumed because people have either not learned to eat them or how to process them. The solution of this problem through an aquacultural research program could have immediate and practical significance to the local fishing industry.

Per capita annual consumption of seafood (mostly fish) in Puerto Rico is twenty-two pounds. However, more than 21 pounds of it is imported, representing a dollar drain from the Puerto Rican economy. Our aquacultural research program combined with efforts to improve the commercial fishing industry might well reserve the

dollar flow by creating a strong local series of fishing enterprises. Preliminary research by the University of Puerto Rico, Department of Marine Sciences reveals that aquaculture can be a profitable venture, but that techniques must be further tested and refined.

Many species of fish, mollusks, crustaceans, and algae inhabiting the fresh, brackish and marine waters of the island promise to become highly successful aquacultural crops. Furthermore, some of these organisms have already been cultured intensively in other countries. Among these forms, the most commonly utilized have been the channel catfish, the cichlid fish of the genus Tilapia, the pompano, the mullet, and a number of shrimp species of the genus Macrobrachium.

Progress in aquaculture throughout the world has been very slow. The practice finds itself at a stage similar to that of agriculture at least 50 years ago. Programs in aquaculture have been generally patterned from experience with the research-teaching-extension approach so successfully applied to agricultural endeavors. Extensive and intensive aquacultural research programs are conducted in experimental units, which are utilized for research in much the same way that field plots are used in investigations on agronomy. Therefore, adequate facilities are required to insure that good training is provided and valid research is conducted. Existing

facilities available in Puerto Rico to conduct research and to offer training at various levels (academic-professional, technical and extension) are insufficient. Suitable facilities will have to be built to eliminate these deficiencies.

The ever-increasing demand for exploitation of the aquacultural resources not only in Puerto Rico but also in the other islands of the West Indies and in Latin American nations, provides new and innovative opportunities to governments and institutions of higher education in Puerto Rico and abroad: to prepare well-trained individuals capable of conducting valid basic and applied research in this field and to supply the present and future demands for aquaculturists in Puerto Rico, other Latin American countries, and our neighboring islands. Since Puerto Rico is so advantageously situated in the West Indies and because of the bilingual nature of a large segment of its inhabitants, the Island is in an enviable position to serve as the "stepping stone" between North and South America.

A research and training center is the site where new ideas are born, developed, and tested. Such a center is also a most effective tool by which to train new individuals in aquaculture and allied fields. Generally, location of such center is at a university. The university facilitates the professional-academic, technical and extension training of individuals. It permits students (under-graduate

and graduate) to assist in the research being conducted at the center and in all other operations of the facility. At the same time, it allows these students to gain experience and to benefit from various types of scientific endeavors. Location of the center at a university makes it possible also to receive the cooperation and seek consultantship of scientists and specialists from other fields who are employed in the institution. An example of such an arrangement between an aquaculture center and a university is the International Center for Aquaculture of the United States, located within Auburn University, Auburn, Alabama.

The present high interest in aquaculture in the industrial sector of Puerto Rico makes it imperative that the government encourage developing adequate technological and scientific knowledge. Scientists, through their investigations and counsel, would provide the necessary information to help in the implementation of aquaculture industries in Puerto Rico; moreover, they would help safeguard the island from unprincipled or ill-prepared entrepreneurs.

Recommendation

The Commonwealth should initiate a program in aquaculture recognizing three main cultural, sociological and economic elements:

(1) the urgent need to train Puerto Ricans and people from other

Caribbean countries and Latin American nations; (2) the dire need to increase high-quality animal protein in the diet of some segments of the human populations inhabiting the above areas, and (3) the industrial (commercial) potential that aquacultural resources exhibit. The program should be centered at the Mayaguez Campus of the University of Puerto Rico. (A proposal for legislation to accomplish this recommendation is appended as Legislature Proposal No. 3.)

Drugs and Pharmaceuticals

Any substance introduced into an organism in a sufficiently high amount will exert toxic or pharmacological effects, that is, it will modify physiological functions. Some compounds, however, exert marked biological effects when introduced into the body in low concentrations. These are known as "biologically active substances". They are called "drugs" from a purely scientific viewpoint, that is, they are compounds that can be employed as tools for the investigation of physiological functions. They can also be called toxins or poisons.

In addition, some of these compounds are medically useful because their biological effects can be employed for the prevention, diagnosis, or cure of disease. These are commonly known as pharmaceuticals or drugs in the more restricted medical sense.

An abundance of biologically active substances exist unknown to mankind in terrestrial plants, animals, and microorganisms. The largest untapped source is believed to be the sea. Although historically man has discovered many pharmaceutical properties of plants by simple ingestion and observation, the successful discovery and development of marine pharmaceuticals today require a highly sophisticated, multidisciplinary approach. Potential marine sources of these biologically active substances include the sea water itself, marine microorganisms, sponges, jelly fishes, corals, starfishes, sea urchins, mollusks, and of course many species of fish.

Knowledge of drugs and toxins of marine origin is important from two separate viewpoints. First, it may lead to developing new pharmaceuticals. Second, knowledge of marine toxins is essential if we want to take advantage of the full potentialities of the sea as a source of food for mankind. We do not want to be fearful of, say, ciguatera poisoning.

As emphasized above, the research and development needed for getting drugs from the sea must be based on a broad, multidisciplinary approach. Accordingly, the process can be successfully accomplished only in an environment with a high level of academic, technological, and industrial facilities. For obvious reasons, it is not only desirable but also essential that such research facilities

should be located near the source of the potential compounds: the sea itself.

Puerto Rico is an ideal place to pursue such activities. It possesses highly developed academic, biomedical, and industrial facilities. Furthermore, all laboratories and research institutions on the Island are located within a few miles from shore.

In addition, the sea surrounding Puerto Rico is tropical and the variety and diversity of marine species, both vertebrate and invertebrate, are maximal in tropical seas. Therefore, the chances of finding new biologically active substances, and eventually marine pharmaceuticals are much greater here than in northern waters.

Finally, there is another factor that may greatly contribute to the research and development of marine drugs: the Puerto Rican pharmaceutical industry. The promotion of research and development of marine pharmaceuticals in Puerto Rico might give these firms the opportunity to help the overall academic and technological development of the community; also the inverse could hold.

A multidisciplinary approach would be needed wherein all the activities are centrally coordinated. Activities would include biological screening, rough identification, extraction and isolation, chemical characterization, pharmacological studies, acute and chronic toxicity studies, clinical testing, and industrial development.

Recommendations

The Government should:

1. Aggressively encourage and finance activities directed toward the identification, characterization, and practical applications of biologically active materials of marine origin.
2. Create a research and development fund part of which would come from pharmaceutical firms established in Puerto Rico, in a manner similar to petrochemical industry contributions to the Conservation Trust Fund.
3. Charter an organization or entity within the framework of the University of Puerto Rico to develop, promote and coordinate multidisciplinary cooperative research programs, and to make and supervise research grants.

FISHING AS A COMMERCIAL ENTERPRISE

Local fish production has not increased much within the last twenty years owing, in part, to depressed financial and technological status of the local fishermen.

Approximately 2,800 people are engaged in commercial fisheries (excluding the tuna canning industry) in Puerto Rico. Of these, only about 1,000 are full-time fishermen. The average annual production per fisherman is slightly over 3,000 pounds, with a value of \$1,500 to \$1,600. Although the production from specific regions

of the Island are greater than in others, the above figures on volume and value are relatively uniform throughout all fishing centers. (Juhl, 1969; Suarez Caabro, 1970). This low level of productivity stems from scarcity of fish resources inshore; lack of knowledge about the off-shore resources, modern fishing methods and gear; obsolescence of fishing craft, and lack of adequate credit facilities.

The fishing fleet includes about 1,300 boats ranging in size from 14 to 40 feet, most of which do not have mechanized fishing gear. As a rule, these boats are not operable off-shore.

The ongoing Fisheries Development Program, under the sponsorship of the Puerto Rico Department of Agriculture and the U. S. Department of Commerce and authority of PL-88-309 (Commercial Fisheries Research and Development Act of 1964) have demonstrated that commercial fisheries production can be increased substantially in Puerto Rico through the adoption of improved vessels, equipment and fishing gear. This has been proven through the activities of the Exploratory Fishing and Gear Tests project undertaken in most of the coastal fishing centers of the Island.

These tests have been conducted over the past five years in over 30 fishing centers of Puerto Rico. The results of the tests indicate that commercially significant fish resources exist in off-shore waters, and that the local production of approximately five million pounds could be substantially increased by harvesting these resources.

The exploratory fishing results demonstrated that fish-pot production from depth greater than 20 fathoms was from three to fifteen times greater than in shallower depth. Traditionally the fish pot, which is the most common gear used commercially, is pulled by hand. This, of course, has limited its use to shallow waters. Based in part on the exploratory results, it is estimated that the total island production could be increased at least threefold, to 15 million pounds annually.

Fishermen need to acquire larger and better equipped vessels to take advantage of the off-shore resources for increased production. To fill this need, two types of vessels have been designed and are considered ideally suited for the local conditions.

To operate these vessels effectively, these men must also be trained in the use (but not limited to), operation and maintenance of modern equipment and gear.

A credit program could be implemented so that the fishermen could acquire vessels of the type designed and tested by the Department of Agriculture, one a 24-foot and the other 40-foot. The Agricultural Services Administration would be charged with the construction and sale of the vessels. The Department of Agriculture would offer a subsidy for the acquisition of these vessels of 50 percent of the total cost up to a maximum of \$5,000. The balance would be financed by the fishermen through the Agricultural Credit Corporation (affiliate of the Department of Agriculture). This Corporation would

provide loans, payable within ten years, to acquire these vessels. Hull and mortgage insurance would be provided through the Office of the Agricultural Insurance, Department of Agriculture.

The fishermen must be adequately trained in order to operate these vessels effectively. Training should include (1) principles of navigation, (2) diesel motor operation and repair, (3) refrigeration, (4) fishing gear, methods and equipment, (5) maintenance of vessel and equipment, (6) marketing and distribution, and (7) principles of small business management.

On the job training should also be available aboard the vessels of the Department of Agriculture or the Department of Marine Sciences of the University of Puerto Rico.

The accompanying table shows estimated four-year budget for this program.

Four-Year Program For Fishery Vessels

FY	No. of Vessels	Subsidy	Insurance Initial	Insurance Following Years	Administrative Expense	Training Expense	Total
1973-74	20	\$75,000	\$26,000	\$ -	\$15,000	\$25,000	\$142,600
1974-75	20	75,000	27,600	26,220	15,000	20,000	163,820
1975-76	40	150,000	55,200	51,060	15,000	22,000	293,260
1976-77	40	150,000	55,200	100,740	15,000	23,000	343,940
		\$450,000	\$165,600	178,020	\$60,000	\$90,000	\$943,620

Recommendation

The Government should establish a program of financial and training assistance to stimulate a strong, locally-based commercial fishing industry. (A proposal for legislation to accomplish this recommendation is appended as Legislative Proposal No. 4.)

GAME FISH

Recreation in the marine environment of Puerto Rico is growing rapidly. Marinas, hotel-resorts, public beach developments, and near-shore housing projects are attracting more investment and more people than ever before. The result has been a sudden decline in the quality of marine recreation, especially for game fishing.

Rapid and uncoordinated development and use of the coastal environment has produced a variety of stresses: accelerated beach erosion, effluent pollution, sedimentation, turbidity, over-fishing and the depletion of other marine life forms upon which the integrity of marine communities depend.

These stresses have had an adverse impact upon the fisheries for commercial as well as for recreational use. The combined effect of the various stresses has been to reduce the supply and quality of marine organisms that fishermen seek. Consequently, fishermen must

spend more time at sea, travel farther from Puerto Rico's shores, or rely on illegal or highly suspect methods of harvest to secure their catch. The current trend of a declining fishing resource is self-perpetuating and works against present promotional efforts aimed at attracting tourists or at satisfying local recreational needs and demands.

The recreational fishing resource has a great potential. Programs are needed to improve the condition of the present resource and then to protect and further develop them. The waters to be included in such a program include the seas, reef systems, estuaries, lagoons, rivers, canals, streams and lakes.

A first step in achieving the full potential of recreational fishing involves a number of changes in managing fishing habitats. After these changes have taken place and protection of the fishing resource is assured, a development program can be undertaken.

Two major factors affect the current quality or condition of fishing habitats: pollution and poor law enforcement. These negative factors will have to be eliminated before any sincere efforts to manage recreational fishing habits can be successful.

Domestic and industrial wastes are dumped into nearly all of our rivers and estuaries, and into many of our lagoons. Some of the lagoons and close, inshore, shallower waters are favorite boating areas. There is no attempt to regulate boat size, horsepower or speed in

these areas. Wave action from the larger boats disturbs marine life in the lagoons and promotes turbidity by stirring up sediments. In some areas, trash, litter, oil, gasoline and sewage from boats and marinas have become serious problems. The scenic wonder, tranquility, and beauty of many of our lagoons are thus ruined for recreational use.

Recommendations

The Environmental Quality Board, working with the Department of Natural Resources, should establish strict environmental controls for rivers, lagoons and estuaries. Separate controls should be organized to regulate the characteristics of allowed boats (size, horsepower and speed) in these areas.

Good fishing attracts residents and tourists which represent money made or lost by local economies, hotels, restaurants, service businesses, fishing guides, boat charters, bait and tackle shops. Many fishing areas in Puerto Rico have not been developed. Others are in poor condition. Attempts should be made to develop, recondition and manage geographically dispersed fishing areas so that no particular areas are subject to overuse. Dispersement would also provide economic stimulus to remote areas at present little used by local sportsmen.

Recommendation

The Department of Natural Resources should locate, inventory and classify known and potential sport fishing areas throughout Puerto Rico where recreational fishing can be initially concentrated and developed.

The lagoons, estuaries, lakes and rivers with their potentially exciting snook (róbalo), tarpon (sábalo) and fresh-water largemouth bass (lobina) fishing are in need of a rest from the destructive use of the long net (chinchorro) and throw net (tarraya). These devices are prohibited by law. Many other laws passed to insure resource protection and recreation diving and fishing are ignored by fishermen and police. This problem is the crux of most environmental difficulties connected with game fishing in Puerto Rico. Good legislation (which we have in part), well-organized and properly enforced (which we do not have) is essential to protect quality resources.

Responsible laws must be established and strictly enforced to protect and attempt to increase our spiny rock-lobster population. Such regulations should establish limits on size of lobsters taken, numbers taken per day, seasons in which they can be taken, and method by which they can be taken. Any form of spear should be prohibited

in the taking of lobsters. Puncture holes in lobsters should be considered evidence that a spear has been used. Spears should be illegal if they are in the same boat with lobster tails. The female lobster, with eggs, should always be released.

Colorful reef fish are indiscriminately harvested by using chemicals and sold to hobby shops and aquariums by professional collectors. This practice should be made illegal. Conchs and turtles, now relatively rare in Puerto Rican waters, must be strictly protected.

The very presence of spear fishermen often drives fish from frequently dived reefs. The image of the man swimming, the sound of the spear gun being fired, the sound of the death struggle by the speared and dying fish, and the presence of blood in the water all combine to set up a conditioned response of fear in many fish at the mere sight of man. This is especially true in large and highly sought-after species, such as groupers and snappers, many of which live long periods on a particular reef. Man's presence is apt to drive them out of the areas where they are hunted. Reefs barren of fish is one result.

Recommendations

1. The Department of Natural Resources should study and evaluate all existing laws and regulations pertaining to sport fishing

and recommend to the legislature a new, up-to-date, and uniform set of laws with corresponding provisions for enforcement centralized under the Department. Such legislation should prohibit spearfishing and the use of chemicals in any marine environment.

2. The Department of Natural Resources should administer the fishing laws and provide training for professional wardens.

SUBCOMMITTEE ON LIVING RESOURCES

APPENDIX

Legislative Proposal No. 1

"To Establish Marine Environmental Sanctuaries."

Legislative Proposal No. 2

"To amend Article 3-A of Law No. 83 of May 13, 1936,
...prohibition of coral extraction."

Legislative Proposal No. 3

"To Establish a Center of Aquacultural Research,
Training and Development at the University of
Puerto Rico, Mayaguez."

Legislative Proposal No. 4

"To Establish a Program of Financial and Technical
Assistance for Commercial Fishermen."

LEGISLATIVE PROPOSAL NO. 1

To create a system of Marine Environmental Sanctuaries, define their location and boundaries, establish provisions for their management and administration, and to assign funds for their immediate protection through law enforcement activities.

Exposition of Motives

Expanding population and a rising standard of living combine to place unprecedented demands on the natural resources of Puerto Rico. The result is progressive deterioration of environmental quality; the air we breathe, the water we drink, the areas in which we take our recreation, plant and animal habitat, and the natural beauty of our Island.

Safeguarding the environment--air, water, land and plant and animal habitats--is a necessity to maintain conditions under which man, as well as wildlife and plants, may continue to exist in a good quality environment while expanding living standards.

The responsibility of the Commonwealth Government includes the exercise of leadership in the wise use of all natural resources, including diverse plant and animal habitats and the interrelated ecological systems found on the land, along the coast and in the ocean waters.

Puerto Rico is blessed with a variety of unique, unusual, and diverse ecological systems, some of which are already set aside as Commonwealth forests. Marine ecological systems are in need of public ownership and management to conserve their outstanding values for future generations to use, enjoy, study and understand, located in settings where man and nature may co-exist but wherein man is a visitor.

Article 1 - This Act may be cited as the "Marine Environmental Sanctuaries Act."

Article 2 - The administration of the Act is the responsibility of the Department of Natural Resources.

Article 3 - The Secretary of the Department of Natural Resources will prescribe and publish administrative policies and regulations as may be required to manage, protect, and develop the Sanctuaries in accordance with public environmental policy.

Article 4 - The Secretary of Natural Resources has authority to grant permission for the removal of plants, animals (marine or terrestrial) and artifacts for scientific study or research purposes, the acquisition of such material by museums and educational institutions, or for the preservation of the integrity of the Sanctuaries.

CORDILLERA SANCTUARY

<u>Point No.</u>	<u>North Latitude</u>	<u>West Longitude</u>
1	N 18°24'54"	W 65°37'36"
2	N 18°20'54"	W 65°24'48"
3	N 18°20'00"	W 65°24'48"
4	N 18°20'00"	W 65°34'30"

CAYO NORTE - ISLA CULEBRITA SANCTUARY

<u>Point No.</u>	<u>North Latitude</u>	<u>West Longitude</u>
1	N 18°21'00"	W 65°16'12"
2	N 18°21'00"	W 65°13'48"
3	N 18°16'00"	W 65°11'18"
4	N 18°13'54"	W 65°12'18"
5	N 18°13'54"	W 65°13'24"
6	N 18°16'18"	W 65°14'42"
7	N 18°16'18"	W 65°16'12"
8	N 18°16'36"	W 65°16'12"
9	N 18°18'32"	W 65°14'24"
10	N 18°20'00"	W 16°15'12"
11	N 18°20'00"	W 65°16'12"

SOUTH VIEQUES SANCTUARY

<u>Point No.</u>	<u>North Latitude</u>	<u>West Longitude</u>
1	N 18°05'36"	W 65°27'00"
2	N 18°07'36"	W 65°20'00"
3	N 18°06'00"	W 65°20'00"
4	N 18°04'30"	W 65°27'00"

NORTH WEST VIEQUES SANCTUARY

<u>Point No.</u>	<u>North Latitude</u>	<u>West Longitude</u>
1	N 18°08'18"	W 65°34'00"
2	N 18°08'18"	W 65°31'00"
3	N 18°07'42"	W 65°31'00"
4	N 18°07'18"	W 65°34'00"

MARGARITA SANCTUARY

Point No.	North Latitude	West Longitude
1 (Isla Cueva)	N 17°57'42"	W 67°04'36"
2	N 17°55'06"	W 67°04'36"
3	N 17°54'24"	W 67°06'30"
4	N 17°54'48"	W 67°12'42"
5 (Punta Aguila)	N 17°57'18"	W 67°12'42"

Boundary from Point 5 to Point 1 is along the coast shore line and includes all publicly-owned mangrove.

ISLA DE MUERTOS SANCTUARY

Point No.	North Latitude	West Longitude
1	N 17°56'30"	W 66°29'12"
2	N 17°56'30"	W 66°26'30"
3	N 17°54'00"	W 66°26'30"
4	N 17°52'24"	W 66°33'00"
5	N 17°53'42"	W 66°33'00"

BAHIA DE JOBOS SANCTUARY*

Point No.	North Latitude	West Longitude
1	N 17°56'42"	W 66°16'00"
2	N 17°56'42"	W 66°10'30"
3	N 17°54'18"	W 66°10'30"
4	N 17°54'36"	W 66°16'00"

*Includes Mar Negro and public mangroves of Cayo de Barca, Punta Pozuelo, and Cayo Caribe.

MONA ISLAND SANCTUARY

Point No.	North Latitude	West Longitude
1	N 18°11'06"	W 67°58'12"
2	N 18°11'06"	W 67°55'00"
3	N 18°07'42"	W 67°49'42"
4	N 18°02'18"	W 67°49'42"
5	N 18°02'18"	W 67°58'12"
1	N 18°11'06"	W 67°58'12"

DESECHEO SANCTUARY

Point No.	North Latitude	West Longitude
1	N 18°24'36"	W 67°30'00"
2	N 18°24'36"	W 67°27'42"
3	N 18°22'24"	W 67°27'42"
4	N 18°22'24"	W 67°30'00"
1	N 18°24'36"	W 67°30'00"

Article 5a - The following Marine Environmental Sanctuaries are hereby created, named and described to preserve their natural environments and ecosystems within their boundaries for recreational enjoyment, scientific study, and conservation education:

Article 5b - Other Sanctuaries may be created from time to time by the Legislature upon recommendations by the Secretary of the Department of Natural Resources. The Secretary will undertake an immediate inventory of all fresh and brackish water lagoons and salt marshes, select from among them and recommend to the Legislature that outstanding and thoroughly representative examples of them be established as Marine Environmental Sanctuaries to serve the public under the purposes of this Act. Recommendations will be made to the Legislature before March 1, 1974.

Article 5c - The Secretary of the Department of Natural Resources may at any time establish a Marine Environmental Sanctuary to serve the purposes of this Act, the existence of which shall be for no longer than 120 days.

Article 5d - Sport and commercial fishing is allowed provided that methods used in these activities are not detrimental to the environment.

Article 6 - The following acts or uses within the Sanctuaries are prohibited; except as authorized in Article 4.

a. Hunt, trap, or extract terrestrial animals and turtles including nests and eggs.

b. Extract, transport, possess, or sell aquatic and terrestrial plants, corals, conches, turtles, lobsters and crabs.

c. Spearfishing.

e. Extract, transport, possess or sell artifacts from caves, ruins, and shipwrecks.

f. Dump, place, leave, discharge or permit the same, of any solid or liquid waste on the land or in the waters of the Sanctuaries.

Article 7 - Violations of the prohibitions in this Act shall be punishable by either a fine of \$500 for each offense, 30 days in jail or both.

Article 8 - The Department of Natural Resources ~~is~~ assigned the initial sum of \$200,000 for the Fiscal Year 1973-74 to establish a Department of Natural Resources Marine Environmental Sanctuary Warden Division, such sum to include personnel, equipment and related organizational and administrative expenses, ~~and~~ subsequent sums as appropriated being part of the total appropriation allocated to the Department.

Article 9 - This Act supersedes provisions of any other Act which may be in opposition to the provisions of this Act.

Article 10 - This Act will become effective 90 days following its enactment.

LEGISLATIVE PROPOSAL NO. 2

Para enmendar el Artículo 3 y adicionar el Artículo 3-A a la Ley Núm. 83 del 13 de mayo de 1936, según enmendada, conocida como Ley de Pesca.

Decrétase por la Asamblea Legislativa de Puerto Rico:

Sección 1 - Se enmienda el Artículo 3 de la Ley Núm. 83 de 13 de mayo de 1936, según enmendada, para que se lea como sigue:

Artículo 3 - Por la presente se declaran propiedad del Estado Libre Asociado de Puerto Rico, de dominio público común y uso público común, todas las especies de peces, moluscos, crustáceos, mamíferos acuáticos, plantas acuáticas, formaciones de corales, caracoles de concha, y demás organismos sésiles, y todas las demás especies que comprendan la fauna y flora marítima, lacustre y fluvial. Podrán ser pescadas, estraídas, aprovechadas y comerciarse libremente con ellas, con sujeción a las restricciones de esta Ley y del Reglamento para su ejecución.

Sección 2 - Se adiciona el Artículo 3-A a la Ley Núm. 83 de 13 de mayo de 1936, según enmendada, para que se lea como sigue:

Artículo 3-A - Queda vedada permanentemente la extracción, transportación y venta de corales o de las formaciones de éstos en los arrecifes de Puerto Rico y de las islas e islotes adyacentes y la importación de corales de países extranjeros.

La violación de las disposiciones de este artículo constituirá delito menos grave penable según dispone el artículo 25 de esta Ley.

Sección 3 - Se asignan al Departamento de Recursos Naturales para la operación del programa establecido por esta Ley durante el año 1973-1974, la cantidad de veinticinco mil (25,000) dólares de los fondos comprometidos del tesoro estatal. Los fondos necesarios para años subsiguientes se consignarán en el presupuesto General.

Sección 4 - Esta Ley empezará a regir noventa (90) días después de su aprobación.

LEGISLATIVE PROPOSAL NO. 3

Para crear el Centro de Acuacultura de Puerto Rico, adscribirlo al Recinto de Mayaguez de la Universidad de Puerto Rico, establecer sus facultades y deberes, y asignar fondos para su operación.

EXPOSICION DE MOTIVOS

Por su condición insular, Puerto Rico dependerá del mar como fuente de empleo y subsistencia en mayor grado con el transcurso del tiempo. Para obtener el provecho máximo deseado de tal situación, es necesario contar con personal altamente adiestrado en las técnicas, destrezas y las ciencias marinas, y otras áreas relacionadas o aplicables. Se requiere un conocimiento más abarcador y profundo del mar que nos rodea y de los sistemas no marítimos que se relacionan con éste, por lo que también es necesario el estudio y la investigación científica y aplicada. Por tal motivo, se requiere una estructura permanente de adiestramiento e investigación en acuicultura que se dedique a adiestrar a todo el personal que requiera la industria, a llevar a cabo estudios e investigaciones que sean necesarias y a desarrollar nuevos productos vivientes para el mejoramiento de la industria.

Decrétase por la Asamblea Legislativa de Puerto Rico:

Artículo 1 - Se crea por la presente el Centro de Acuicultura de Puerto Rico y se adscribe al Recinto de Mayaguez de la Universidad de Puerto Rico.

Artículo 2 - Se asigna a la Universidad de Puerto Rico para la operación del Programa establecido por esta ley durante el año 1973-1974, la cantidad de ochocientos ochenta y siete mil (887,000) dólares de los fondos no comprometidos del tesoro estatal. Los fondos necesarios para años subsiguientes se consignarán en el Presupuesto General.

Artículo 3 - Se faculta y autoriza al Rector del Recinto de Mayaguez de la Universidad de Puerto Rico, o a su representante legal, a:

(a) Nombrar y contratar los funcionarios, técnicos y empleados, y a comprar el material y equipo necesario para llevar a cabo cualquier aspecto del programa.

(1) El Rector podrá, con el consentimiento del Senado Académico o la Junta Administrativa, según sea el caso, excusar del cumplimiento con las disposiciones de las leyes de Personal y Servicios pertinentes, cuando la aplicación de las mismas puedan ocasionar perjuicio o impedimento en el desarrollo de los programas.

(b) Establecer facilidades experimentales en el área de La Parguera y de la Subestación Experimental Agrícola de Lajas, utilizando por lo menos 15 acres de superficie acuática e igual cantidad para facilidades terrestres.

(c) Coordinar dentro y fuera de Puerto Rico lo relacionado con la acuacultura a nivel académico, industrial y comercial.

(d) Mantener estrecha cooperación con los Laboratorios de Pesquería Marina del Departamento de Agricultura (Punta Guanajibo, Mayaguez); División de Caza y Pesca del Departamento de Agricultura; y otras entidades o dependencias análogas.

(e) Proveer asesoramiento técnico al Gobierno y a la industria privada en todo lo relacionado con acuacultura; al igual que establecer y operar proyectos pilotos para el desarrollo de nuevas especies marinas y el desarrollo de nuevas técnicas y procedimientos.

(f) Proveer oportunidad de adiestramiento académico, científico y técnico para todo aquel que cualifique, incluyendo estudiantes de Latinoamérica, islas del Caribe y otros países.

(g) Iniciar o contratar estudios en áreas de interés para la acuacultura tales como: cuestiones de derecho, cuestiones administrativas, cuestiones sociales o culturales y otras que afecten directa o indirectamente a la acuacultura.

(h) Desarrollar, implementar y administrar los programas académicos, técnicos y de investigación básica y aplicada relativos a la acuacultura, del Centro de Acuacultura de Puerto Rico.

(i) Establecer la reglamentación original y suplementaria necesaria para la operación del centro dentro del sistema universitario.

Artículo 4 - El Rector delegará en el funcionario que nombre para dirigir el Centro de Acuacultura de Puerto Rico, aquellas funciones compatibles con el cargo, incluyendo las anteriores.

Artículo 5 - Esta Ley entrará en vigor el 1 de julio de 1973.

LEGISLATIVE PROPOSAL NO. 4

Para establecer un Programa de Ayuda a Pescadores Para Adquirir Embarcaciones Pesqueras y Adiestramiento y para establecer un Instituto de Pesquería ambos adscritos al Departamento de Recursos Naturales, facultades y deberes: facultades y deberes de la Administración de Servicios Agrícolas, Corporación de Crédito Agrícola, Oficina de Seguros Agrícolas y del Laboratorio de Pesquería al respecto; asignar fondos para su operación.

EXPOSICION DE MOTIVOS

El Programa de Fomento Pesquero actual ha sido efectivo en demostrar la posibilidad de aumentar la producción de pescado y el mejoramiento de los ingresos del pescador mediante el uso de

embarcaciones y equipo mejorado. Por lo tanto, la creación de una industria local pesquera con buena base económica no es sólo posible, sino también deseable. A la vez, el margen tan amplio entre la producción local, el consumo y la creciente demanda ofrecen un reto económico muy prometedor.

Dudamos, no obstante, que los recursos disponibles en la región costanera a profundidades menores de 20 brasas puedan producir lo suficiente para absorber la demanda. Los proyectos emprendidos en la actualidad van dirigidos al desarrollo y expansión máxima de la pesca costanera y además a profundidades mayores de 20 brasas. Tal nuevo enfoque conlleva cambios considerables en tipo de embarcaciones, equipo de las mismas, atavíos de pesca, adiestramiento y métodos operacionales.

Nos proponemos desarrollar un programa de ayuda a los pescadores para que ellos puedan adquirir barcos pesqueros del tipo contruidos y aprobados por el Departamento de Recursos Naturales y reciban el adiestramiento pertinente para la adecuada operación de los mismos.

Decrétase por la Asamblea Legislativa de Puerto Rico:

Artículo 1 - Se crea por la presente el Programa de Ayuda a Pescadores Para Adquirir Embarcaciones Pesqueras y Adiestramiento, adscrito al Departamento de Recursos Naturales.

Artículo 2 - Se asigna al Departamento de Recursos Naturales para la operación del Programa establecido por esta ley durante el año 1973-1974, la cantidad de ciento cuarenta y dos mil seiscientos (142,600) dólares de los fondos no comprometidos del tesoro estatal. Los fondos necesarios para años subsiguientes se consignarán en el Presupuesto General.

Artículo 3 - Se faculta y autoriza al Secretario de Recursos Naturales a:

(a) Nombrar y contratar los funcionarios, técnicos y empleados necesarios para llevar a cabo cualquier aspecto del programa; disponiéndose, que dicho personal será nombrado sin sujeción a la Ley Núm. 345 de 12 de mayo de 1942, que crea la Oficina de Personal.

(b) Comprar el material y equipo necesario para llevar a cabo cualquier aspecto del programa, disponiéndose, que dichas compras se efectuarán sin sujeción a la Ley Núm. 150 de 9 de mayo de 1945, según subsiguientemente enmendada, que crea la Oficina de Servicios del Gobierno de Puerto Rico.

(c) A negociar con la Administración de Servicios Agrícolas, a quien por la presente se faculta para la construcción y venta a los pescadores partícipes del programa, de las embarcaciones que

reciban aprobación del Departamento de Recursos Naturales.

(d) A ofrecer un incentivo a los pescadores partícipes en el programa de un 50 por ciento del costo total de las embarcaciones hasta un máximo de \$5,000.00, en la adquisición de los mismos.

(e) A negociar con la Corporación de Crédito Agrícola, a quien por la presente se faculta, para conceder préstamos a los pescadores partícipes, con las embarcaciones como colateral, para la obtención de las embarcaciones del inciso (c) supra, hasta por un máximo de diez (10) años.

(f) A negociar con la Oficina de Seguros Agrícolas, a quien por la presente se faculta, la expedición de pólizas de seguros sobre las embarcaciones y el equipo; a efectuar el pago de las primas correspondientes; y a designar al Departamento de Agricultura como beneficiario de las mismas.

(g) A contratar la construcción, ampliación, conversión, renta o adquisición de facilidades adecuadas de almacenaje, refrigeración y transportación de los pescados obtenidos por los participantes del programa.

(h) A emitir, aprobar, enmendar y derogar reglamentos para llevar a cabo los objetivos de esta Ley.

Artículo 4 - Se establece el Instituto de Pesquería, como el

organismo que descargará la función de enseñanza y adiestramiento objeto de esta Ley.

Artículo 5 - El Instituto desarrollará, implementará y administrará un programa de enseñanza y adiestramiento académico y práctico que incluya, entre otras, las siguientes materias: navegación; mecánica y mantenimiento de equipo diesel, electrónica, refrigeración, equipo de pesca y embarcaciones; técnicas de mercadeo y distribución.

Artículo 6 - El Instituto utilizará las facilidades del Laboratorio de Pesquería del Departamento de Recursos Naturales y otras facilidades disponibles para llevar a cabo sus funciones educativas.

Artículo 7 - Esta Ley entrará en vigor el 1 de julio de 1973.

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SECTION 2 -- REPORT OF SUBCOMMITTEE
ON RECREATION

INTRODUCTION

It is a paradox that in Puerto Rico, an island surrounded by excellent waters, blessed with favorable breezes and a tropical climate, that water sports and marine recreation are not fully developed. The reasons stem from fear of the water by many residents, lack of daylight hours for many residents to enjoy the beaches and lack of low-cost marine facilities. An important factor comes from the need for creative actions and supporting funds for those charged with developing the marine recreational potential of the Island.

MANAGEMENT

The Parks and Recreation Administration does not have an office or section to handle or develop maritime recreation. Lack of communication between this agency and the people has seriously restricted its creativeness with respect to the development of marine recreation. The Parks and Recreation Administration is not conscious of many of the needs and desires of the public or of the vast recreational potential the sea represents. In addition, it does not seem to have the power or ability to coordinate with other government agencies at Federal and Insular levels.

Recommendation

A mechanism should be established within the Parks and Recreation Administration to permit citizen participation in water-sports and recreation policy formulation.

For many miles, especially around the San Juan metropolitan area, beaches are littered, uncared for and unsafe because there is no governmental agency assigned responsibility for their custody. For years, different agencies have been shunning that responsibility and blaming each other. Because all our beaches are public, the Government should maintain them.

Recommendation

The Parks and Recreation Administration should be given the responsibility for guaranteeing adequate cleaning and maintaining of all beaches. In addition, and most important, the Governor should give the Administration the means to do the job, and funds should be appropriated for this purpose.

As more and more boats take to our beaches, swimmers, skin-divers and surfers will be increasingly endangered. Accidents involving small motor boats and swimmers will be more common in

the future if no safety measures are taken.

Recommendation

Motor boats should be prohibited on especially designated areas of our beaches and speed limits should be established for motor boats used near beaches.

Because we are close to the equator, our day is relatively short. We know that most developed countries have exchanged unproductive morning daylight hours for recreational afternoon daylight hours by means of establishing Daylight Saving Time during the summer months. This system has improved the economy as well as the quality of life of the people by providing additional hours for recreation.

Puerto Rico is precisely in the southernmost position where Daylight Saving Time can work without sacrificing productive morning daylight hours. Sunrise in the shortest day of the year in Puerto Rico is around 7:00 A.M. In the six months of Daylight Saving Time (from 20 April to 20 October) sunrise in the shortest day is around 6:00 A.M. Therefore, if clocks are moved ahead one hour, we would have as much daylight in the morning hours as in the winter months, while in the afternoons we could enjoy one more hour of

sunlight. Undoubtedly, this extra hour of sunlight would mean more recreational time available to the citizen.

An important additional benefit would be the considerable savings of electrical power at a time when such economizing is immi-
nently desirable.

Recommendation

Daylight Saving Time linked to the Federal system should be established in Puerto Rico.

FACILITIES AND DEVELOPMENT

The waters on the coast from San Juan to Luquillo are usually rough, but could be avoided. By merely following the natural course of marshlands and of man-made drainage channels, a water route can be traced between San Juan Bay and Luquillo Beach. That a waterway could be created along this route seems technically feasible, although probably costly. In fact, a waterways study for the San Juan Metropolitan Area¹ recommends the extension of such fluvial routes as far east as Vacía Talega. Given the demand for scarce public funds, it is unlikely that such a waterway will soon be built. However, the availability of an intra-coastal protected waterway would stimulate pleasure boating and would also

¹"San Juan Waterways Transportation Project," Puerto Rico Public Works Department, September 1971.

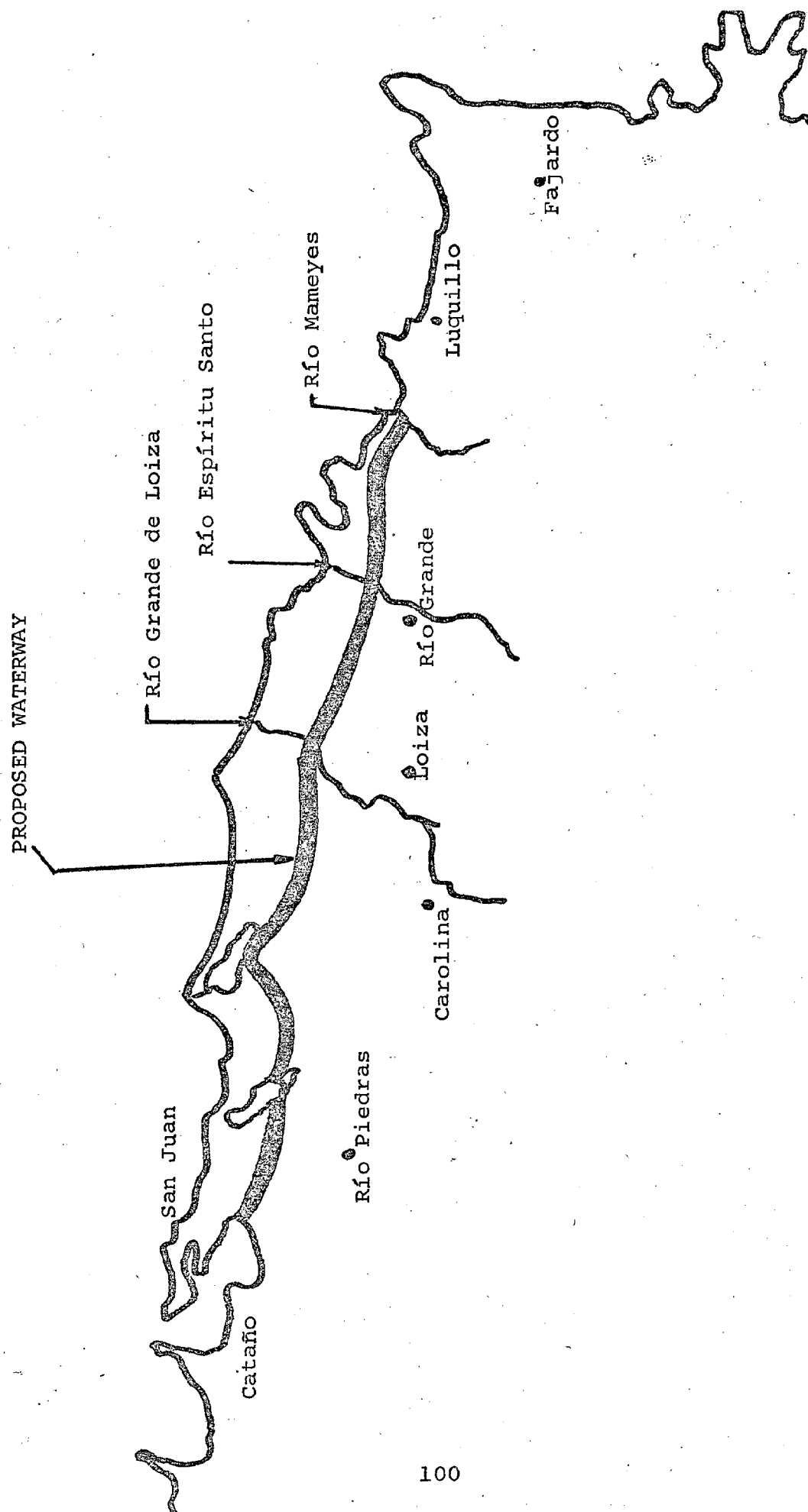
create beneficial side-effects. It could (a) create new economic activity along its route, (b) offer alternate mass transportation means for population centers near its route, (c) offer a commercial route for cargo, (d) provide a mechanism for limited sand extraction.

The proposed waterway need not follow the path of least resistance from San Juan to Luquillo. For instance, along the Espíritu Santo River there are stands of mangrove and estuarine waters worthy of conservation. At such points, the waterway should be designed to avoid intruding on these assets. Where the route must traverse mangrove areas the integrity of which we desire to maintain, the waterway could be designed to minimize its impact on the shore.

This Subcommittee feels that regardless of how long it may take to ultimately complete such a waterway, its planning should begin. (See map of San Juan-Luquillo Inland Waterway.)

Furthermore, it need not stop at San Juan Bay on its westward thrust. The causeway between Palo Seco and Cabras Island is of recent and artificial vintage. Cutting it, to provide water linkage from Boca Vieja Bay and the Punta Salinas area to San Juan Bay and then eastward via Martín Peña Channel, San José Lagoon, the Suárez Canal, Torrecillas Lagoon, Piñones Lagoon, Machicóte Channel, the Loíza River, the Medianía Canal, the Herrera and Espíritu Santo Rivers, and cutting across the base of Punta Miquillo and Punta Picúa to the mouth of the Mameyes River in front of Luquillo Beach,

SAN JUAN - LUQUILLO INLAND WATERWAY



would open up an excellent marine waterway at little cost to public funds and with many worthy side benefits, including the cleaning of San Juan Bay.

Recommendation

A study should be made of the technical feasibility and environmental effects of a canal to be dug inland parallel to the coast from San Juan to Luquillo.

Over-fishing and other excesses have depleted commercial and game fish around the Island and certainly the supply must be brought back to normal. It has been shown that the establishment of artificial reefs increases fish population over natural reefs.

Recommendation

We endorse the research program seeking the development of viable artificial reefs as proposed in the Report of the Subcommittee on Research and Development.

Thousands of residents of San Juan lack the transportation facilities to enjoy beaches that are not within walking distance of homes. Lacking practically any other type of recreation, the

less affluent city dwellers flock to the beaches from Puerta de Tierra to Punta Las Marías on week-ends. With the exception of one or two beaches such as, El Escambrón, no public lockers or sanitary facilities exist in that stretch of beaches. The result is a situation of disorder and uncleanness along the Condado and Isla Verde beach strip. This same stretch of beach is supposed to be one of our principal tourist attractions.

Recommendation

Public locker, sanitary, and cafeteria facilities should be established along the beaches from Puerta de Tierra to Punta Las Marías at strategic points and they should be supervised by safety personnel.

Our best beach facilities are closed at least one day a week, usually Mondays. Moreover, closing time is the same during winter and summer months not taking into consideration the additional daylight available during the summer.

Recommendation

All public beaches should be kept open every day of the year and during the summer months the closing time should be extended

in direct relation to the length of the day.

Because of the prohibitive cost of available waterfront property, the sports of game fishing, motor boating, water skiing, skin diving and sailing up to the present have been enjoyed principally by the more affluent individuals. Many others who would like to participate in such sports and may be able to afford the necessary equipment, are unable to do so because of the lack of facilities for economically storing and launching their craft. Unlike most maritime nations including Communist Bloc countries, Puerto Rico does not offer its citizens adequate boat storage and launching facilities.

The facilities that currently exist are primarily located in a few long-established private clubs or are commercially oriented and geared to the larger power and sail boats which demand deep-draft slips commanding rentals of at least \$40 per month. The needs of the average would-be boating enthusiast who could afford a small sail or power boat priced upwards from \$300 are not being effectively met. The public facilities developed by Government agencies have not been adequate; the launching ramps were so poorly designed or located that they promptly broke up or were otherwise rendered useless.

The one exception to this situation is the Yachting Facility at the Isla Verde Public Beach developed in 1966 as a Yachting Training Center for the Central American and Caribbean Games. At no cost to the public, it has continued to serve as a center for small sailboat activity. The facility consists of a fenced-off acre of land leased for a fee of \$100 per year to the Federación Nautica de Puerto Rico. This group regulates amateur yachting on the Island, and represents all one-design fleets, yatching clubs and organizations. Its commodore is the yachting delegate on Puerto Rico's Olympic Committee.

The Federación financed the construction of a sail storage building with sanitary and meeting room facilities. The building is furnished with boat storage racks at fees ranging from \$50 to \$75 annually. It now stores well over 100 boats of various types, and has become a center for sailing activities, such as free lessons and week-end regattas for the sailing enthusiast, whether or not his boat is stored there. This center has been a boon to the development of sailing skills, and some of the boat owners have been participants in national and international events, such as the Olympic Games.

Given Puerto Rico's urgent social needs and relatively scanty financial resources, it is unlikely that public funds for recreation

would be diverted to marinas. Nevertheless, there is a demand for them. We believe that private capital can be marshalled to satisfy that demand if public lands located near suitable bodies of water and population centers are made available for their development along specified guidelines.

Marine recreation centers could be developed on these lands and could include a wide spectrum of facilities such as deep-berth moorings for keelboats and large power cruisers, bulkhead hoists for dry-sailed boats, dry-boat storage, trailer parks, marine shops, haul-out repair yards, cold storage for fish catches, and marketing outlets for fish catches. These centers would serve the needs of power and sail pleasure cruising, commercial and sports fishermen, skin and scuba divers, and competitive sailing enthusiasts. The centers could also provide space for three other important activities which would concern the total boating population: (1) A training center for marine-related skills, developed in conjunction with vocational training programs, (See fourth Recommendation under the Education and Culture subheading); (2) Marine clubhouses or meeting places within the marine center grounds where groups with common interests could meet and work to promote their goals, and (3) Minor marine-craft manufacturing centers, where fiberglass hullworks, sail lofts or other such nautical gear could be constructed.

In sum, the key idea is that all the above-mentioned socially desirable goals could be accomplished without relying on the public treasury for their achievement if public lands could be leased on reasonable terms to the developers, who could be selected through a bidding process, and who would be required to comply with pre-designated specifications and operational policies.

Recommendations

1. Facilities should be provided by the Parks and Recreation Administration for the storage of small non-motorized boats at various public beaches in Puerto Rico, along the lines of the Isla Verde Facility, as managed by Federación Náutica de Puerto Rico.
2. Public land should be leased on reasonable terms to private developers for the construction of recreational and commercial marine centers at appropriate locations. A mechanism to implement this recommendation should be established by statute including environmental safeguards and others such as public hearings on lease terms and prices charged for use of facilities on public land.

Puerto Rico lacks all-weather harbors; because of this, very few small pleasure craft cruise around the Island and prefer to go

to the nearby Virgin Islands. The ports of towns such as Naguabo, Yabucoa, Patillas, Arroyo and Santa Isabel are good anchorage spots only if the wind blows from the East and North. However, when the wind shifts the waters of these ports lose all their gentleness.

The development of all-weather harbors around the Island would definitely create a new dimension to local boating, and would also attract visiting boats to our Island.

In addition, all-weather harbors would enable local commercial fishermen to have bigger, safer, and more seaworthy boats. At present, most boats are limited to small 17-18 foot craft that can be beached to protect them from rough seas.

Recommendation

A study should be made on the feasibility of economically transforming several ports in the Island's coasts into all-weather harbors by designing and constructing breakwaters.

Because of its strategic location in the middle of the Metropolitan Area, San José Lagoon is the body of water with the most recreational potential in San Juan. Its stagnant and polluted waters prevent giving any serious consideration to recreation plans. Therefore, the cleaning of the San José Lagoon must be initiated as soon

as possible.

The following methods are suggested for further consideration:
(See also Appendix A)

1. Reversing the pumps of the flood-control station of Llorens Torres in order to pump clear sea-water into the lagoon, thus eventually cleaning the water in it.
2. With the use of a lock on Canal de los Suárez, a system of tide control could be set up to allow clear water into San José Lagoon from Cangrejos-Torrecillas. This would prevent a reverse flow and, in fact, would produce flow augmentation in Martin Peña Channel.

Recommendation

An extensive study should be made to develop a way to clean and maintain the San José Lagoon.

San Juan Harbor was prevented from cleaning itself in a natural way when the causeway from Palo Seco to Isla de Cabras was built. Thus, San Juan Harbor is at present heavily polluted and there is no outflow except through the mouth between El Morro and Isla de Cabras, which is an unnatural exit. Also, a canal across the causeway could provide access inside the reefs to the new

Bayamón River channelization. (See diagram of Isla de Cabras Causeway Canal.)

Recommendations

1. Strict measures should be taken against polluters of Condado Lagoon and San Juan Harbor, especially against those emptying industrial wastes and oil. (See similar recommendation of Subcommittee on Coastal Zone Management.)

2. A feasibility study should be made of the dredging of a canal from San Juan Harbor westward across the present causeway of Isla de Cabras that would help flush San Juan Harbor, and also permit limited navigation of small passenger ferries.

In our waters there are no locations designated as underwater gardens or trails for skin-diving enthusiasts to visit, such as those in several of our neighboring islands.

Recommendation

Certain submarine locations should be chosen and designated as underwater trails for the enjoyment of skin divers and underwater photography enthusiasts. (See also similar recommendation in the report of the Subcommittee on Research and Development.)

ISLA DE CABRAS CAUSEWAY CANAL

ATLANTIC OCEAN

Isla de Cabras

PROPOSED CHANNEL

OLD SAN JUAN

ISLA GRANDE

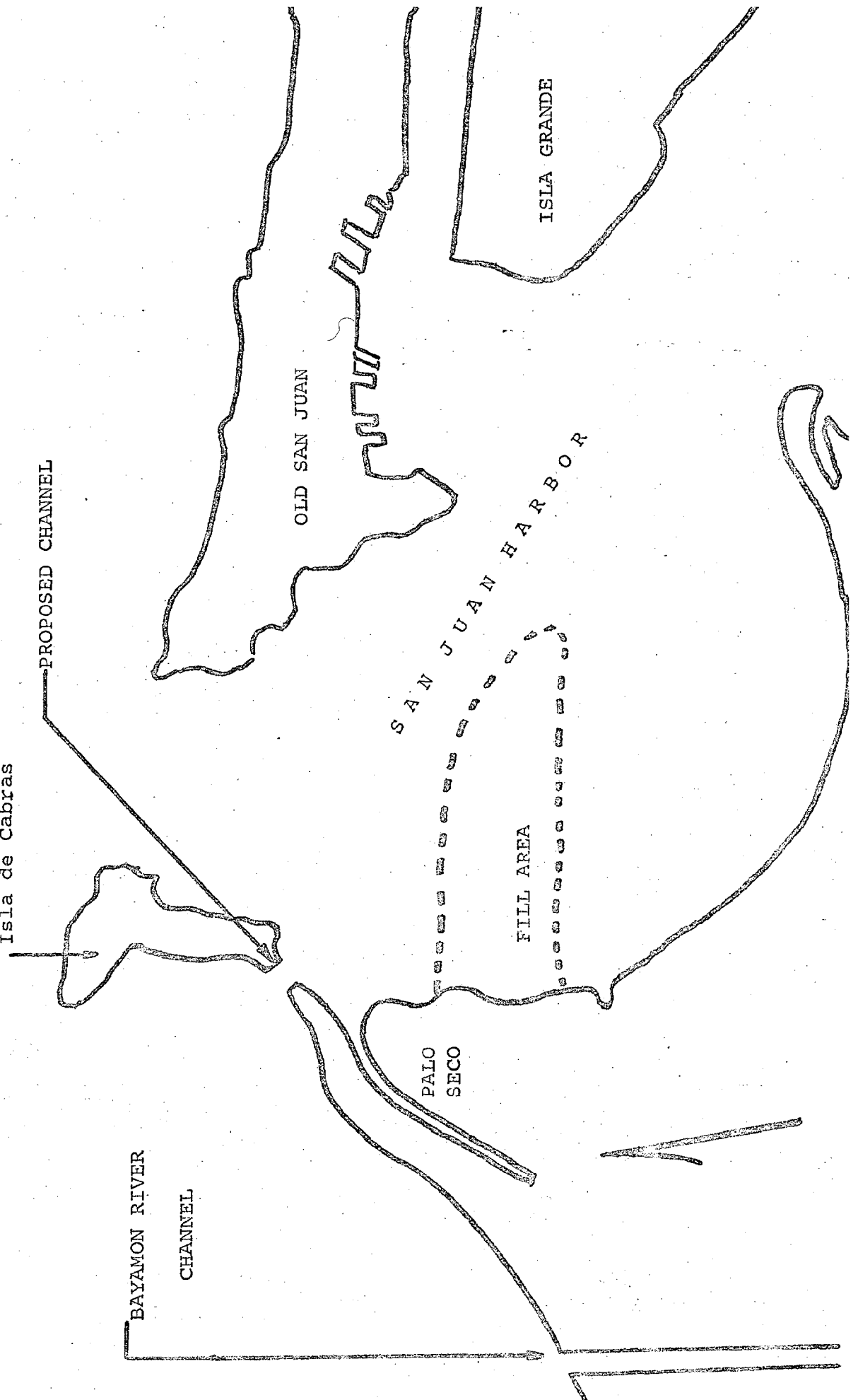
SAN JUAN HARBOR

FILL AREA

PALO
SECO

BAYAMON RIVER

CHANNEL



The roads at some of our most scenic spots either do not have a parking area or the spot is used as a garbage dump.

Recommendation

Scenic spots on our roads should be identified and parking and observation platforms should be built on them. Regulations to prevent use of coastal areas as garbage dumps should be enacted and the means to prosecute violators should be provided.

(See also similar recommendation in the report of the Subcommittee on Coastal Zone Management.)

Ignorance of the sea, its life and potential also contribute to the local attitude of regarding the ocean as a menace. A program should be started to instruct people in the use of the sea recreationally and commercially.

Recommendation

Public swimming pools should be built at or contiguous to the present athletic fields in every town in Puerto Rico.

EDUCATION AND CULTURE

Although we live totally surrounded by water, too many of our people are taught from early childhood to be afraid of the ocean. Therefore, relatively few learn how to swim and cannot fully take advantage of the pleasures or the work opportunities the sea can offer.

Recommendations

1. Swimming and water safety should be introduced in all schools at all levels as part of the regular curriculum.
2. Marine educational programs should be established in all schools and Government radio and television stations should include the sea as one of the principal subjects in its programming. (See also similar recommendations in the reports of the Subcommittees of Research and Development and Institutional Arrangements.)
3. A program should be established within which schools, governmental agencies, associations, clubs, and other institutions concerned with the sea may present exhibits for the instruction and enjoyment of the general public.

There is great potential for jobs related to marine recreation that is not being tapped because available young people are not

trained in the various necessary skills. Most skilled marine personnel are non-Puerto Ricans.

Recommendation

Vocational schools should extend their curriculum to include training in the different maritime-oriented fields such as marine electronics, marine mechanics, life saving, and boat building.

APPENDIX A

CLEANING SAN JOSE LAGOON AND MARTIN PEÑA CHANNEL

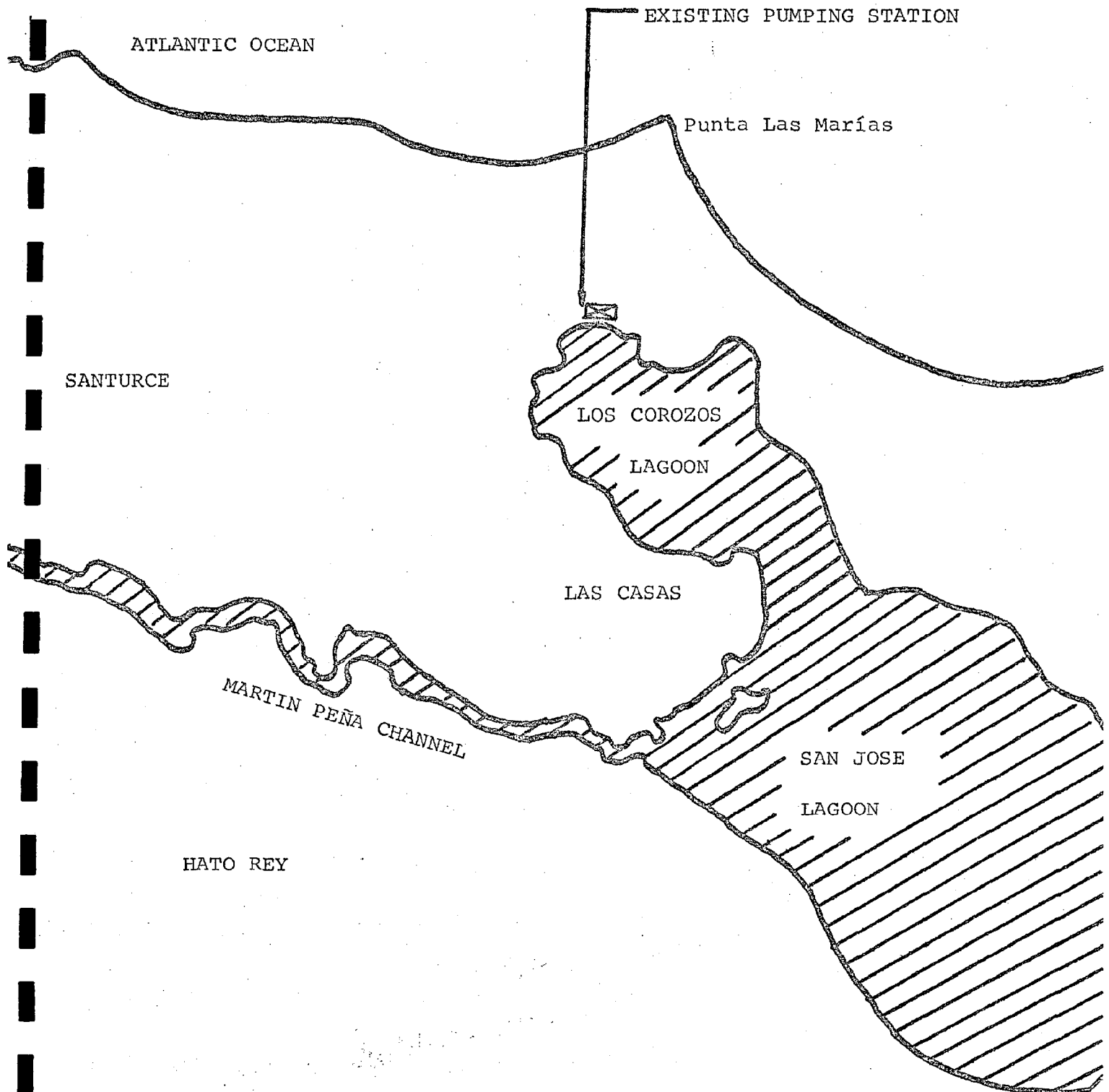
The plan of cleaning San José Lagoon and Martín Peña Channel by pumping sea water into Laguna Los Corozos appears surprisingly inexpensive. (See Figure showing Pumping Station Proposal.)

On September 1970 the firm of Buck, Seifert and Jost, Consulting Engineers to the Puerto Rico Aqueduct Sewer Authority, stated in their report titled The Collection and Disposal of Sewage in the San Juan Metropolitan Sanitary District that "immediate alleviation of conditions in Martín Peña Channel can be realized through flow augmentation by pumping 1,000 cfs from the Atlantic Ocean to Los Corozos Lagoon."

In their report, Buck, Seifert and Jost recommend the installation of pumps of 1,000 cfs capacity. They further state that flow augmentation provided with such pumps "would provide the greatest return in improvement of water quality per dollar expended."

However, they did not realize that at the present time there is a pumping station located at Los Corozos Lagoon with a capacity of 1,250 cfs. Because its purpose being flood control of San José and Los Corozos Lagoons, this pumping station located at Baldorioty de Castro Avenue across from Llorens Torres Public Housing project, is

PUMPING STATION PROPOSAL



idle practically all the time.

Mr. Alfredo Heres, a noted Puerto Rican civil and sanitary engineer, was asked about the feasibility of installing a system so that the flow of the pumps could be controlled in such a fashion that on dry days, the pumps would pump sea water into Los Corozos Lagoon and or in rainy days, they could be switched back to original position. He emphatically expressed his opinion that the project is completely feasible. Not only are the pumps there but their capacity is well above that required to clean out San José Lagoon and Martín Peña Channel. The cost of reversing the flow of the pumps would be nominal compared to the good effects brought by it.

Although the possible effects on nature by pumping sea water into San José Lagoon should be given careful study, the healthier conditions of the Lagoon and Martín Peña Channel brought about by the pumping would appear to outweigh any other considerations.

SECTION 3 -- REPORT OF SUBCOMMITTEE ON
COASTAL ZONE MANAGEMENT

INTRODUCTION

The coastal zone* is Puerto Rico's most critical natural resource. This encircling band of shorelands and coastal waters is critical, first, because of its present and potential contributions to the Island and its people; and second, because of the demands inevitably focused upon it by the development of ports, industries, power plants, homes and recreation facilities.

During the remainder of this century, recreational use of the coastal zone is expected to grow dramatically as a result of increasing population, mobility and leisure. Simultaneously,

*The term "shorelands" is used in this report to describe the strips of land that comprise the interface between the interior lands of Puerto Rico and the waters of the Atlantic Ocean and the Caribbean Sea. The term "coastal zone" includes, in addition to the shorelands, the coastal waters and the submerged lands lying under the coastal waters, out to the limit of Commonwealth jurisdiction. This usage is adapted from A Description and Analysis of Coastal Zone and Shoreland Management Programs in the United States, by Earl H. Bradley, Jr., and John M. Armstrong (Coastal Zone Management Project, Sea Grant Program, University of Michigan, Ann Arbor, Michigan), Draft Edition, March 1972.

shorefront development of all kinds will continue its gradual encirclement of the Island. (See map, "Coastal Projects - 1972.") The character of this development will profoundly influence the quality of life in Puerto Rico well into the 21st century and beyond.

Most concerned Puerto Ricans already recognize these facts. What many do not realize is that the pattern of shorefront development will be largely determined within the next ten years--and is even now being quietly determined for several key areas. Even where no development is yet contemplated, rising land prices reflect the expectations of owners that they, too, will be allowed to build at the densities now being permitted.

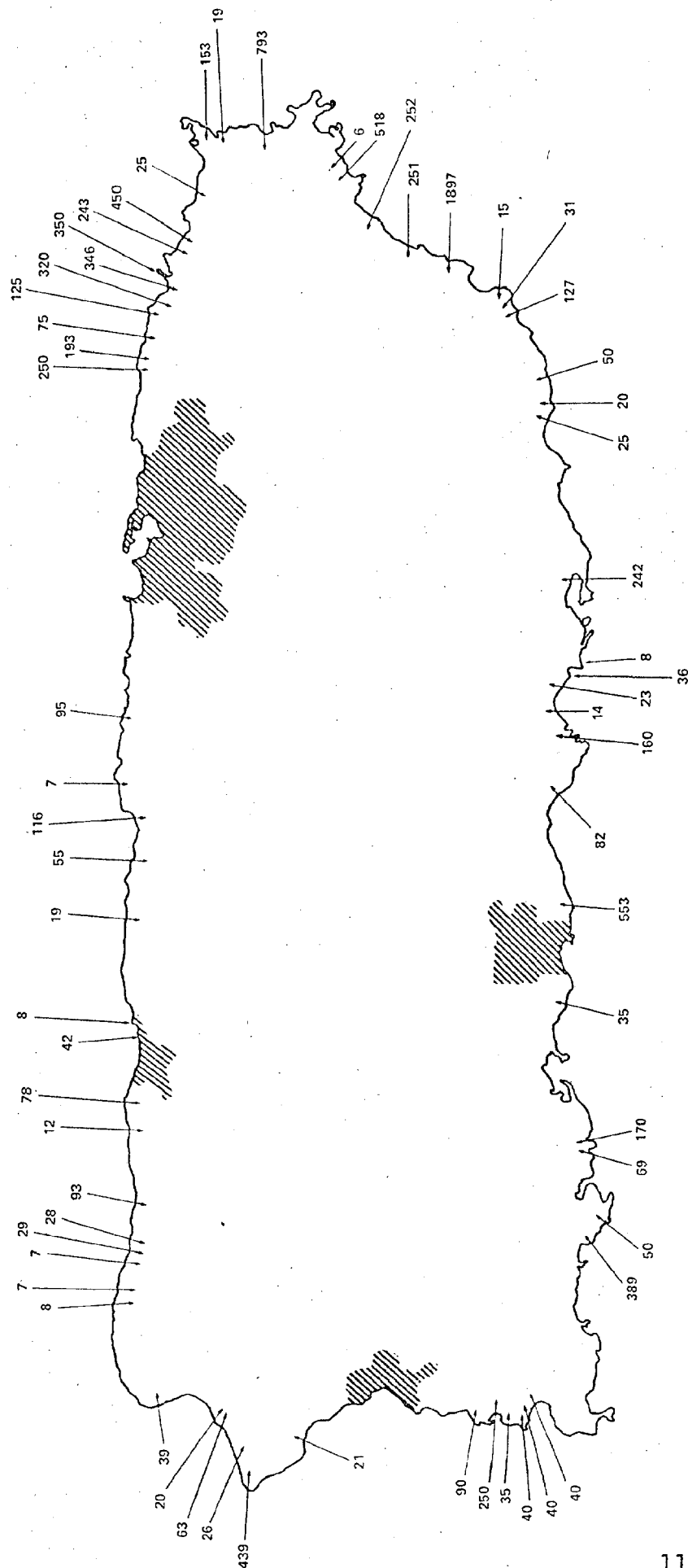
To guide these development pressures in the public interest, we see a clear need for policies and plans. Policies, adopted after thorough public discussion, should establish public objectives and designate means to achieve them. Adopted plans should apply these policies to the varying conditions found in different parts of the coastal zone. Finally, implementation measures should be instituted to achieve desired action.

This report considers policies and implementation mechanisms in four problem areas: access to public shorelands, Land use-

COASTAL PROJECTS - 1972

APPROVED OR UNDER CONSIDERATION (SHOWN IN CUERDAS)

Projects developed or near completion not included



guidance, protection of coastal waters and public information and involvement. The Subcommittee has approached these problems with an awareness that committee reports too seldom stimulate action. The members are familiar with dozens of reports whose criticisms, exhortations, and sound recommendations have had no discernible effect. In fashioning its recommendations, therefore, the Subcommittee has repeatedly sought ways to increase the likelihood of responsive action.

This quest for action has proven especially difficult because the coastal zone clearly needs planning. The desirability of detailed planning (in addition to formal policy making) seems beyond real doubt.

Even the broad policies considered in this report are closely interrelated, and numerous other public objectives should properly be considered in addition. All these policies and objectives must then be applied to conditions that vary greatly from place to place within the coastal zone. Only a planning process, not a rigid formula, can achieve multiple objectives under these conditions.

Although planning is sometimes seen as part of a process for limiting or deterring development, the Subcommittee has repeatedly encountered situations in which planning would aid development at the same time that it would help conserve natural resources and

environmental quality. Whether the issue is beach-access requirements or the location of proposed water-supply systems, developers would often benefit from a planning process that would tell them, authoritatively, what the Government will require of them and what services it plans to provide. At present, in the absence of plans, the developer faces delays and uncertainty that can cost him more than he would spend to comply even with tough coastal-zone development standards.

At this point, two unpleasant realities must be acknowledged. First, the development of Puerto Rico's coastline is being allowed to proceed without significant guidance from policies or plans. Formal policies, establishing meaningful directions for public action, are rare. Plans, although sometimes prepared, are seldom adopted and rarely applied. Regulations, upon which the public must place principal reliance in guiding the development of private property, normally lack the refinement needed for effective plan implementation and environmental protection.

Second, every investigation, whether official or unofficial, whether concerned with planning or land development, or the environment or natural resources, invariably recommends planning. This has been true for many years. Why, then, haven't the recommendations produced a meaningful planning process? Realistic recommendations depend on the answers to this question. Some

possible problems--and responsive suggestions--are:

1. Lack of awareness. Perhaps the Government--and, ultimately, the people--have simply not thought the need great enough to insist on planning. We must therefore urge that the problem is important, and recommend mechanisms to convince the public and their officials. Fortunately, awareness of coastal-zone problems has risen sharply in recent years. Interest in these problems has also risen in the United States, with the result that major proposed legislation on the subject is now before the Congress.* This legislation, if enacted, will make new funding available for coastal-zone-management programs and should be of substantial help in creating additional awareness of the problems here.

2. The Legislature has failed to provide needed powers and funds. More planning authority, more regulatory power, more money are thus required. This report points this out in some places. More money for land purchase is badly needed. In the case of

*For example, one coastal zone bill (H.R. 14146) was passed by the House of Representatives on July 31, 1972. A land-use pouch bill, which would require the development of plans and programs for areas of "critical environmental concern" (beaches wetlands, etc.) was passed by the Senate on September 19, 1972.

planning and regulatory authority, however, the essential authority has been on the books for 30 years. Additional authority, while needed, is not the heart of the problem.

3. The failure may be caused by problems of bureaucracy, with agencies tied up in their own red tape because of traditional lack of policy orientation and secrecy. It is therefore necessary to assign functions to new agencies (e.g., Department of Natural Resources). This report does not designate agencies for most responsibilities, deferring instead to the recommendations of the Subcommittee on Institutional Arrangements. Unfortunately, assignment to new agencies seems likely to be beneficial only in the short run because the same bureaucratic disabilities seem likely to afflict all agencies sooner or later. As a more permanent measure, it will be necessary to remove some of the secrecy and other sources of bureaucratic difficulty.

4. The dynamism and resources of the private market may have simply overwhelmed governmental efforts to guide development. The most effective response to this problem, it appears, is to change the rules in such a way that the dynamism of the private sector will be infused directly into the planning process. Two kinds of changes can be identified as tending toward this result.

The first of these changes is to improve the quality of ad hoc

project review. Coastal projects are submitted to an array of ad hoc reviews. Even though most of the coastal zone lies outside the areas covered by zoning, most projects need approval from the Planning Board. Many projects require approval also from the Public Service Commission, the Environmental Quality Board, the Department of Tourism, or Federal agencies. Since 1970, Commonwealth law has required that environmentally significant projects be evaluated in Environmental Impact Statements, which are circulated among agencies and the public. Although some of these reviews are more effective than others, all are valuable. As our only operating weapons to defend the coastal zone against misuse, they must be vigorously applied. None of these reviews, however, are adequate substitutes for a planning process. Indeed, some of the reviews are more costly and time-consuming than they would be if the coastal zone were planned. A plan, by making fundamental choices after consideration of all alternatives, can resolve issues that otherwise must be reconsidered in some depth in connection with each project. In an important sense, therefore, these increasingly sophisticated review procedures are desirable, not only for their direct effect on individual projects but also because they tend to create additional demand from developers for a more rapid, effective planning process.

A second change is to apply more stringent requirements in the

absence of plans, with the result that plans will often ease restrictions instead of adding to them. At present, the absence of plans is often used as a reason for not imposing needed limits on development. The plan becomes a step toward restriction; without it, the traditional pattern of opportunistic development may continue. As a result, developers have insufficient incentive to demand plans--even when they realize that planned development of a whole district could benefit their property. This situation needs to be reversed. Protective requirements should apply in all coastal areas except those where plans have shown that deviation from the requirements will not harm the coastal zone. Accordingly, we suggest the establishment of some requirements to protect unplanned coastal areas. Though inevitably only an approximation of the public interest, these requirements would provide some essential protection. They would also stimulate private demand for planning.

Enforcement, like planning, presents some practical problems. One response is to authorize citizen suits so that private citizens can compel governmental agencies to enforce relevant legislation. This would relieve the Government from some of the pressures to which it traditionally has been subject.

After considering the likely effect of these measures, the Subcommittee remains gravely concerned about the extent of the damage already done to our coasts and about the difficulty of

bringing balance to the tradition of developmental opportunism that is permitting this damage to continue. There is, however, basis for hope. The new environmental awareness in Puerto Rico, the prospect of new Federal assistance for coastal zone management, the new Department of Natural Resources with its statutory charge to concern itself with the coastal zone, are all hopeful signs. It is thus with cautious optimism that the Subcommittee has examined the specific problems of the coastal zone.

ACCESS TO PUBLIC SHORELANDS

Historically, public access to beaches and other shorelands has seldom been a problem in Puerto Rico. Unfortunately, there is a tendency to assume that the problem will never arise here or that it has already somehow been "solved". Several misapprehensions are common:

"There are so many beaches. And lots of them don't seem to be used much." It is true that Puerto Rico has hundreds of miles of shoreline, including some 70 miles of beaches with good recreation potential. But the day of the remote, little-used beach is rapidly passing: radical increases in automobile ownership and responsive improvements in the highway system are seeing to that. Like development, public recreation demand is rapidly being diffused over most of the Island's coasts. The question must be faced

whether all beaches and other shorelands will be available to satisfy that demand or whether some beaches will be effectively set aside for occupants of shorefront hotels, condominiums, and other property.

"But aren't all the beaches in Puerto Rico public?" Public rights in the maritime zone ("zona maritima-terrestre")* have been established by law since Spanish times. With only a few exceptions, some of which are far from clear, the citizen has a legal right to enjoy the beaches if he can get to them. This, however, is often a problem. That problem becomes serious when new development does not provide new public access points. It becomes more serious still when developers are allowed to block the rutted tracks that provided access in the days before many people wanted it.

*"The 'terrestrial maritime zone' shall mean the space of the coasts of Puerto Rico touched by the sea during its ebb and flow, where tides are noticeable, and where the largest waves during a storm are felt in places where tides are not noticed, and it includes the lands recovered from the sea and the river borders up to the place where they are navigable or where the tides are noticed; and the term, notwithstanding any condition, shall mean the terrestrial maritime zone of Puerto Rico." 23 L.P.R.A. 2103 (n).

"But development in San Juan hasn't blocked beach access. You just walk to the end of one of those dead-end streets. Surely new development will provide this kind of access." This is not necessarily so. The pattern of development is different today. New tourist complexes, for example, even when located on huge tracts, often do not establish any public streets at all. Besides, the public will increasingly be arriving at the beach by car, not on foot, so the old dead-end street pattern isn't really adequate anyway.

In the past, Puerto Rico has rarely encountered the beach exclusion problems that plague so many places in the United States and the Caribbean. The Island could well experience them in the future, however, together with the resentments and tensions they inevitably create. Steps are needed, and needed now, to assure that they do not arise as a result of developments now being approved.

The Subcommittee recommends the following policy for the Government: All people should have equal opportunity, in fact as well as in law, to enjoy the beaches and other public shorelands of Puerto Rico's maritime zone. Shorefront development, governmental and private, should be designed to facilitate rather than obstruct shoreland access by the general public. Although use of designated shorelands may have to be regulated in the public interest (e.g., restriction of access to critical environmental areas

needed for scientific study), regulations should apply equally to all persons. De facto segregation of public beaches, as a result of development patterns that facilitate use by shorefront landowners while obstructing or preventing access by the general public, is explicitly rejected as unacceptable anywhere in Puerto Rico.

Extent of Public Ownership Rights in Shorefront Areas

At the outset, implementation of the policy stated above requires clarification of existing public rights in shorefront areas. A number of legal issues need to be resolved, and boundaries between public and private land need to be clearly delineated. Without these clarifications, private interests too often override public rights.

Crown Grants

In a few parts of the Island, owners of shorefront property claim that grants from the Spanish crown entitle them to exclude the general public from portions of the maritime zone. If valid grants do exclude the public from extensive areas, governmental action may be needed. An essential first step is to determine the extent and validity of the grants.

Recommendation

Puerto Rico should, by statute, require registration of all crown grants that are claimed to authorize exclusion of the general public from any portion of the maritime zone. The statute should establish a reasonable registration period, of perhaps one year, after which (1) unregistered grants would be void, and (2) the validity of registered grants would be expeditiously adjudicated in a manner fixed by the statute.

Delineation of Maritime Zone

The maritime zone has an inconvenient characteristic: it moves with the shoreline. Over a period of years, depending on wave action, it may "retreat" seaward or "advance" over private property. Especially since the construction of dams has restricted the amount of river sands being deposited along the coasts, the "advance" of the maritime zone has been notable in some places. Although delineation of the zone is difficult because of this movement, it is nonetheless essential in order to safeguard public rights.

Recommendation

Puerto Rico should conduct a continuing survey to delineate the maritime zone with precision, and should publish the result

in convenient form. The Legislature should appropriate funds sufficient to permit this enlargement of the present delineation program.

Servidumbre de Vigilancia

In addition to the maritime zone, the Spanish Ley de Aguas of 1866 appears to have conferred another unique legacy on the people of Puerto Rico. This law establishes a servidumbre de vigilancia (easement of vigilance) that extends inland six meters from the landward edge of the maritime zone.* The purpose of this easement as originally conceived was for the state to have access to the beaches to be able to detect and exercise control over vessels navigating close to shore. Wherever the six-meter strip is impassable, the laws require that the shorefront landowner permit authorized people to pass at a convenient place nearby. If these

*Similar provisions were included in the Ley de Puertos of 1880; however, the validity of the servidumbre may be questioned under the law (See letter from Wallace Gonzalez Oliver, Secretary of Justice, to Enrique Soler Cloquell, President of the Planning Board, dated April 24, 1972).

provisions still apply,** then the servidumbre has often been ignored in recent years.

Today, as concern about pollution and its consequences (such as fish kills and oil spills) accentuates age-old needs for vigilance over coastal areas, it is essential that the existence of the servidumbre be definitely determined, publicized and enforced. The servidumbre creates, for purposes of coastal vigilance and also perhaps for other purposes, a right of passage along the entire coast of Puerto Rico. To create such a right anew, if it did not already exist, would be enormously burdensome and expensive.

Recommendation

Puerto Rico should definitely determine the continuing validity of statutory provisions establishing the "servidumbre de vigilancia". If the servidumbre shall exist, its existence should be publicized, both among shorefront developers and among the general public.

**See Robert Armstrong vs. Commonwealth, 97 D.P.R. 588 (1969).

Other Legal Issues

There is need for a convenient and definitive source of information to resolve a number of legal uncertainties about public rights in the coastal zone. Needs Include:

1. Determination whether owners of offshore islands have the right to exclude the public from the maritime zone surrounding those islands. These beaches and coastal areas on these islands should be considered under Puerto Rico's coastal zone laws, so that the owners could not prevent public access.
2. Determination of remedies available to a person wrongfully excluded from the maritime zone or from a servidumbre.
3. Determination whether the benefits of the 20-meter servidumbre de salvamiento, also established by Spanish laws, are limited to victims of shipwrecks, and whether that servidumbre restricts development of the land to which it applies.
4. Determination of public and private ownership rights in mangroves.
5. Determination whether or not public access rights to shorelands may have been obtained by prescription as the result of public use over a period of years. Likewise, determination that public access to the shorelands is protected under the police power of the state to authorize development. These rights to be considered

as easements can be an important source of access. Their extent in Puerto Rico, and a convenient means of locating them on the ground, should be clearly established.

6. Determination of the practical effect, in coastal areas, of the rule that allows private persons to obtain legal title to some kinds of public land by occupying it for a prescribed number of years.

Recommendation

The Government, aided by private organizations such as the Bar Association or the Conservation Trust Fund of Puerto Rico, should prepare a definitive legal policy analysis establishing the extent of public ownership rights in coastal areas and recommending legislative or administrative measures necessary to strengthen or protect those rights.

Exclusion of Squatters from Maritime Zone

Lackadaisical and hesitant law enforcement over a period of many years, has encouraged squatters--both rich and poor--to build illegal structures in the maritime zone. An effective mechanism is needed to put an end to this practice and to compel removal of existing illegal structures. Since experience demonstrates that

Government agencies often find it politically delicate to assert the public right in these cases, statutory authorization of citizen suits may be the most feasible approach.

Equitable considerations probably require that some limitations be placed on the right to bring citizen suits. For example, a statute authorizing citizen suits generally might nevertheless bar them against: (1) structures built, pursuant to a valid building permit, before the effective date of the statute; and (2) structures that were built before the effective date of the statute and that are subject to a valid compliance plan, filed on record by the owner, agreeing to remove the structure within a reasonable amortization period not to exceed 10 years after the effective date of the statute.

Recommendation

The Government should, by statute, give any citizen standing to seek a mandatory injunction requiring immediate removal of illegal structures located in whole or in part within the maritime zone. Such citizen rights should supplement, rather than replace, enforcement rights now available to the Government.

Access Rights Following Artificial Shoreline Changes

To assure continuity of public access rights despite artificial shoreline alterations, the right of access should extend to new land created along the shore to man-made beaches, and to newly dredged channels.

Recommendation

All permits for dredging and filling should be conditioned on dedication of an easement of public access to any resulting new land, beaches, or channels. Legislation, assuring that such dedication will be mandatory in appropriate cases instead of resting within the discretion of regulatory agencies, would also be highly desirable.

Beach Access

The maritime zone, especially if augmented by the servidumbre de vigilancia, could be thought of as a pedestrian right-of-way that performs some of the functions of a highway. It is reasonable, then, that highway plans include connecting roads to link shoreline right-of-ways with the entire Island network of streets and highways.

Highway planning, however, is far from enough. Although properly located highways can remove physical and legal barriers that

bar shorefront access, this is only a first step. The more important need is for plans to assure access. Such plans should consider several variables:

1. The varied character of the coastal zone itself from place to place. Long, continuous beaches need different treatment from rocky headlands.

2. The varied means by which access can be established. For example, coastal access can be assured by designing new shorefront highways at locations that preclude the construction of buildings between the highway and the coast. Access can also be provided by providing a series of intensive-use facilities (such as Luquillo Beach), with nearby shorelands accessible to those who walk along the shore from those facilities. Other possibilities include permitting physical pedestrian access from a street near the shore and providing a place to park, access by hiking or boat alone if the firm intent is to preserve the area in its undeveloped form.

3. The varied ways in which people enjoy using the maritime zone. Dune buggies and bird watching do not mix. Some activities will surely have to be restricted by regulation, and limited areas will have to be set aside for activities such as picnicking, sports, etc. Far more effective, however, would be a planned access system that naturally restricts some areas for the less intensive uses.

There is no need to make all shorefront access equally convenient:

some of the more rugged areas can be effectively reserved for use by a hardy few.

Plans drawn up for beach access should also:

1. Provide for public facilities (including, where appropriate, highways, public beach installations, parking facilities, pedestrian access ways) sufficient to remove legal and physical obstacles that could exclude the general public from enjoyment of the maritime zone.

2. Recognize that public demands on the maritime zone will change in ways not now foreseeable and, accordingly, seek to prevent the creation of new property rights that could prevent future governmental response to these changing demands.

Development of the coastal zone is generally preceding, rather than following, the planning process. Plans of the kind just recommended either do not exist or are not being followed. Other mechanisms are needed, therefore, to assure that development does not permanently prevent public access to the maritime zone.

As already noted, older patterns of residential subdivision provided beach access points that are of enormous importance today in the urban areas of Puerto Rico (e.g., the dead-end streets that provide access in the Condado). Newer developments, however, are not following conventional subdivision patterns. Many tourist

complexes are not being subdivided into lots, and new residential developments are following more imaginative subdivision designs.

Regulatory requirements have not yet been adapted to this new context. Although existing Planning Board regulations do appear to require access in connection with smaller subdivisions, the regulations do not establish clear-cut access requirements for many of the projects now being built. As a result, access requirements are only established on an ad hoc basis, usually without public awareness or discussion.

As might be expected, the ad hoc requirements vary unpredictably from project to project. In some projects, obscure rights-of-way are required. (One hotel, which was authorized to install fences that prevent public passage along the oceanfront, was required to establish a public right-of-way connecting the beach with the hotel parking lot. It is unclear to the Subcommittee--and presumably to the public--whether there is a legal right of public access from the highway to the parking lot.) In other projects, no right-of-way is required at all, or transportation to the beach is controlled entirely by the project management. The theory in these cases may be that adjacent property owners will be required to provide access when they subdivide or develop their land.

Clear-cut requirements are essential if effective public access is to be guaranteed. California legislation, which bars subdivision

unless "reasonable" access is available, suggests the principle that ought to underlie those requirements. It is probably true, however, that this principle (properly extended to include major developments as well as subdivisions) is approximately the principle that is already being applied on an ad hoc basis in Puerto rico. The difficulties arise in assuring that the principle is applied consistently and in deciding what the principle means in individual cases.

In addition to establishment of the principle, therefore, several regulatory provisions are needed:

1. A basic or fail-safe requirement to assure minimally adequate beach access. This might provide, for example, that beach access be provided at intervals of approximately 1,000 meters, with the interval never greater than 2,000 meters unless necessary for health, safety, or environmental reasons. It might further prohibit coastal subdivisions and substantial coastal developments unless these requirements are satisfied by (a) existing (not planned) streets or rights-of-way in the vicinity, or by (b) streets or rights-of-ways dedicated across the property being developed or subdivided.

2. A flexibility provision authorizing adopted plans affecting the coastal zone to make these requirements either more stringent (e.g., in dense urban areas) or less stringent (e.g., in industrial areas or where natural conditions preclude access), so long as the basic principle of reasonable access is maintained.

3. A public notice and hearing requirement to assure public awareness of any development that may have the result of foreclosing access.

Recommendation

The Government should establish by regulation or legislation a (1) declaration of beach access policy, (2) a basic shoreland access requirement, (3) a flexibility provision enabling adopted plans to vary the basic requirement, and (4) a public hearing requirement to assure public awareness of projects that may foreclose access.

LAND USE GUIDANCE

In addition to foreclosing public access, uncontrolled coastal development often needlessly destroys the natural character of the shorelands themselves. Avoidable destruction has already occurred in many parts of the Island. Indeed, if effective mechanisms to guide development are not established soon, much of the opportunity to prevent further destruction will disappear. Highways, industries, and condominiums, each located in accordance only with the needs of its promoter, will soon have set basic patterns that future development will have to follow. And many of those patterns will result in the dredging, filling, and paving over of the very shorelands that attracted the development in the first place.

The need is for a balance between the needs of development and those of preservation. Since present practices are overbalanced in favor of development, a policy of balance will give new weight to preservation of natural shoreland conditions. "Shorelands" here refers to all those areas, both publicly and privately owned, whose natural features (such as dunes, vegetation) are primarily determined by the proximity of the sea. (See footnote, Introduction). This policy is not intended to discourage coastal development, it is intended to discourage avoidable disruption of the natural processes

that create the unique utility and beauty of shorelands. Nor is this policy intended to promote government ownership of those shorelands that lie landward of the maritime zone; it is intended to protect the natural front yard of an Island facing the sea.

Recommendation

The Government should adopt the policy that coastal development should, to the fullest practicable extent, preserve the natural character of the shorelands that surround Puerto Rico.

Coastal-Zone-Management Policies and Plans

To achieve balanced development, Puerto Rico needs to establish clear and specific policies for the guidance of land use and development in coastal areas, instead of merely reacting on an ad hoc basis to project proposals initiated by private corporations and public development agencies. The policies should serve as a basis for comprehensive coastal-zone-management plans.

The policies and plans should then be implemented by all feasible guidance mechanisms that are needed to assure effectiveness. In a few areas, these mechanisms should include public purchase of land or other property interests such as easements or development rights. In remaining areas, regulations should be established, supplemented

where possible by income and property tax incentives.

The Subcommittee wishes to call attention to a recent report, Coastal Zone Management in Florida - 1971, issued by the Florida Coastal Coordinating Council in December 1971, which illustrates the kind of planning approach needed here. The report classifies land and water areas "utilizing the three basic categories of 'Preservation' (no further development), 'Conservation' (limited development permitted), and 'Development' (suitable for intensive development). 'Preservation' areas would protect ecologic units of sensitive flora and fauna as well as areas, of dunes, marshes and swamps. 'Conservation' areas would include hurricane and flood plain zones usable for parks, open space, greenbelts, and other non-intensive uses. 'Development' areas would include those lands with soils and topography suitable (or suitable with minor corrections) for intensive development. The geographic extent of each category in the pilot area has been mapped using aerial photography, soil surveys, topographic maps, and spot field checks. Totals for land zoning categories in (the pilot area) are: Preservation, 6.5%; Conservation, 30.5%; and Development, 63%. Environmental aspects and uses for each 'Preservation' and 'Conservation' category are enumerated."

The Subcommittee is impressed by the need for speed in the planning process. Funds for coastal-zone planning must be made

available soon and must then be quickly put to use. Measures that do not depend on completion of plans, some of which are recommended later in this report, must be taken at once. Even so, a great deal of development is likely to take place while plans are being prepared. During this interim period and perhaps afterwards, some mechanism appears to be needed to enable private developers to aid public planning efforts. In a sense, developers are already providing such aid when they prepare Environmental Impact Statements for important projects. These Statements, however, come after development is proposed. Some mechanisms must be found to enable developers and property owners to expedite area planning beforehand, thereby avoiding the intolerable delays that result when public decision-making takes place almost entirely in response to permit applications. These plans should provide for the public enjoyment of the maritime zone by preserving the natural variety of coastal areas and respecting the varied ways in which different people enjoy those areas.

Recommendations

1. Comprehensive coastal-zone management policies and plans should be formulated and adopted to provide for protection and development of the coastal zone. Measures to expedite the planning and decision-making processes, including measures enabling developers to

help expedite area planning, should be given particular attention.

2. The Environmental Quality Board, in consultation with the Planning Board, should be charged with setting up broad coastal zone policies and plans; the Department of Natural Resources should prepare detailed plans and establish procedures for their implementation.

Protection of Critical Environmental Areas

A few areas within the Island's coastal zone should be designated "Critical Environmental Areas" because they are especially deserving of protection. Phosphorescent bays, important reefs, sanctuaries, and significant mangroves, are examples of such areas. Natural features in these areas warrant the establishment of stringent protective measures that do not apply elsewhere. Several, in fact, are suggested by the report of the Subcommittees on Living Resources. Therefore, even though current and future studies will permit additional designation later on, there is no need to await completion of those studies before taking action to preserve the most important of these critical areas.

A program to protect Critical Environmental Areas should comprise the following elements:

1. A mechanism that assures the designation of the Areas in a manner that is fair and that inspires public confidence is needed.

Designation by an appropriate agency, after publication of a thorough report and public hearings, seems a minimum requirement.

2. Appropriate restrictions should be imposed on Critical Environmental Areas including at least the following: (a) Establishment, as an emergency measure if necessary in specific cases, of a special procedure, to include mandatory public hearing, that must be followed before any development of such areas; and (b) establishment of particularized controls after negotiation with property owners. The procedure established by the Massachusetts Wetlands Act is a most useful model to follow. After expiration of a short appeal period, these particularized controls would become permanent restrictions and would be recorded in the Registry of Property.

There should be subclassifications of Critical Environmental Areas (e.g., critical reefs, littoral areas, watershed areas, mangroves areas, sanctuaries, phosphorescent water areas, wetland areas, offshore islands), to permit establishment of restrictions suitable for the special needs of the areas in each subclassification. (The Report of the Subcommittee on Living Resources details some of the special considerations needed for sanctuaries.)

3. To facilitate designation and assure fairness, a series of economic incentives should be established to benefit private owners of Critical Environmental Areas. As a minimum, any area subject to

permanent restrictions should be assessable, for tax purposes, only at its market value as so restricted. In addition, income tax laws might properly be amended, if necessary, to permit the owner of a Critical Environmental Area to donate its development rights to Puerto Rico and to deduct the value of that donation from income tax (perhaps without regard to the 3 percent exclusion now applied before gifts become deductible).

4. Because incentives will not be sufficient to assure preservation in every case, the Government should start a program to acquire appropriate scenic easements, development rights, or even full property ownership in those Critical Environmental Areas whose natural character cannot be effectively preserved by other means. Although requisite legal authority for such a program appears to be provided by the Land Administration Act, funding needs to be significantly increased. Given the magnitude of the need, substantial sums should be included in the budget for the purchase of property rights in Critical Environmental Areas. The monies earmarked for this should be separate from sums appropriated for the purchase of recreation lands. Insofar as practicable, the sums appropriated, combined with those appropriated for recreation land purchase, should be sufficient to provide the matching funds necessary to obtain all available Federal open-space grants.

5. New administrative arrangements should be established for maintenance of Critical Environmental Areas. Regional committees of trustees seem especially suited for this need.

Recommendation

The Government should, by statute, authorize the designation of Critical Environmental Areas, including provision for regulation and maintenance of those Areas, for the granting of tax incentives to their owners, for the purchase of easements or other property rights when necessary to assure preservation.

Protection of Areas Suited for Intensive Use

Just as some coastal areas are uniquely important for preservation, others are uniquely suited for intensive uses as ports, power plants, and heavy industry. Designation of the limited sites suitable for these intensive uses is essential, just as in the case of Critical Environmental Areas. Indeed, outright public acquisition of these sites is probably even more urgent than in the case of the preservation sites. Efficiency and pollution control appear to dictate that these activities be concentrated within limited coastal areas. This planned concentration in turn seems likely to accentuate further the rise in land prices, which could, in the view

of some observers, begin to price Puerto Rico out of the market for future developments of the type described.

Several agencies, including the Planning Board, Fomento, and the Water Resources Authority, are currently preparing location studies for sites that could anticipate future intensive uses. These studies are indispensable. A land-acquisition program is also essential, however, to assure that the chosen sites remain available.

Recommendation

The Government should inaugurate an immediate program to acquire full property ownership (or, where sufficient, easements or development rights or other lesser property interests) of the relatively few remaining coastal sites suitable for ports, power plants, and heavy industry.

Regulatory Measures

In the "ordinary" coastal areas, unlike the limited areas designated as critical for preservation or intensive use, Puerto Rico must rely almost entirely on regulations to carry out its coastal land-use guidance program. At present, land-use regulation of outlying coastal areas is ineffective. Intensive

developments are arising at scattered sites, often preceding fundamental public decisions such as the size and location of major highways and utilities and the development densities they could support.

Several Puerto Rican agencies have statutory authority to guide development in coastal areas. The planning Board has extensive jurisdiction, while the Environmental Quality Board has power over environmental aspects. The new Department of Natural Resources will have powers over coastal zones, and the Department of Tourism will oversee development in areas of tourist interest.

Density Limitations

Given the record of administrative agencies, the Legislature may itself wish to impose strict limits on development in unplanned coastal areas. The establishment of density limitations would be a feasible regulatory measure. This measure would achieve basic protection in that the formal adoption of policies, plans, and regulations would become an essential prerequisite to development at urban intensities.

Recommendation

The Government should, by statute, prohibit intensive residential development of the coastal zone (other than rural development on small existing lots or at an intensity of not more than one or two families per cuerda) unless the project is either (1) connected to an existing public sewer system or (2) is to be developed in accordance with a formally adopted coastal-zone management plan that makes adequate provision for roads, sewerage, public open space, and other necessary facilities.

Setbacks

Unless sensitively planned and designed, shorefront highways and buildings often destroy the natural quality of the shorelands over which they pass. Given the extreme difficulty of achieving sensitive design, a setback requirement, limiting development to the area behind the shorelands, has great potential as a protective device.

Ideally, any setback should itself be determined by a plan. Setbacks would then vary from place to place, taking account of areas subject to flooding (including flooding by high waves during storms); areas whose development would result in removal of protective dunes; wetlands and other areas of important coastal vegetation;

areas in which high-rise buildings would cast shadows on recreational beaches in the maritime zone, etc.

Florida legislation* provides for establishment of setback lines, on the basis of comprehensive engineering studies and topographic surveys, to assure protection of upland properties and the control of beach erosion. The statute considers of factors such as "ground elevations in relation to historical storm and hurricane tides, predicted maximum wave uprush, beach and offshore ground contours, the vegetation line, erosion trends, the dune or bluff line if any exist, and existing upland development...."

The Florida experience may have important carry-over value here. One Florida official* describes the process for establishing the setback in the following way:

We have used the 20 years storm surge, plus two feet of wave set-up, plus the Mean High Water level to arrive at a "combined water level" (this is a still water level). We use the "combined water level," various wave characteristics, and the offshore and beach profile as input to a computer program which calculates how high up the beach the wave will reach.

Generally, no building (or seawall) should be reached by the wave uprush. In addition, no structure should be built in such a way that it will destroy the major sand dune (here we use a

* Section 161.053, Florida Statutes, enacted June 25, 1971.

* * Letter from Mr. W.M. Sensabaugh, Engineer, Bureau of Beaches and Shores, State of Florida, to Cruz A. Matos, Executive Director, EQB of Puerto Rico dated August 1, 1972

setback from the centerline of the dune). If the dune is so low that it is overtopped by the waves in the computer program, then we use a formula which is based on the average annual rate of erosion in the area in question.

To date, we have essentially completed the study of 44 miles of shoreline, in 1,000 foot increments. We have found a wide variation of the height and width of the beach and dunes within this continuous 44 miles. This points out the need for a comprehensive study with sufficient flexibility in criteria to allow for changes in the shoreline. In Puerto Rico the changes in the shorelines are more severe and occur more frequently, therefore, comprehensive study and flexibility will be even more important to you than they are to us.

Established, although informal, practice in Puerto Rico sometimes results in substantially larger setbacks for some new projects than would be mandated by the Florida approach. Aesthetics and other objectives do unquestionably warrant larger setbacks in many instances, and those factors should continue to be considered. The Florida approach would, however, provide a rational basis for a consistently applied and essential minimum setback.

Where plans are not yet available to serve as the basis for a requirement tailored to the individual situation, a uniform ocean-front setback can provide a measure of protection. This has long been recognized in Puerto Rico, and a substantial setback has sometimes been required. Unfortunately, this has been done on an ad hoc

basis, depending on the project. To attain consistent protection, several regulatory provisions are needed:

1. Enactment of a basic or fail-safe setback requirement.

This might fix a basic setback distance from the ocean (perhaps 30 or 50 meters) plus, in the case of buildings more than two stories high, any greater distance necessary to prevent the casting of shadows on beaches in the maritime zone during specified daylight hours.

2. A set of exception for the benefit of small tracts (smaller than about 5 cuerdas) that existed before the setback requirement went into effect. Unlike a large tract, where a setback will rarely decrease the total quantity of permitted development, a small tract can be rendered largely or even wholly useless by a large setback requirement. Fairly generous exceptions for established small tracts seem worth granting in order to achieve legal and political acceptability for measures that protect large tracts that are being developed for the first time.

3. A flexibility provision authorizing adopted plans including those prepared pursuant to the Florida approach to establish either greater or smaller setbacks, so long as consistent with the basic policy of the regulation or statute.

4. A public notice and hearing requirement to assure public awareness of any project for which a plan has authorized a setback smaller than the basic setback.

Recommendation

Puerto Rico should establish, by regulation, a (1) declaration of shorefront protection setback policy, (2) basic shorefront setback of perhaps 30 or 50 meters, (3) set of exceptions for the benefit of small existing tracts, (4) flexibility provision enabling adopted coastal-zone-management plans to vary the basic requirement, and a (5) public hearing requirement to assure public awareness of projects for which plans permit a smaller setback. (In addition to regulations, or in place of them, legislation establishing these requirements would be highly desirable.)

Special Problems

Several additional problems warrant attention in addition to measures already recommended. These involve the protection of the material as well as aesthetic values of our beaches.

Dunes

Although dunes play an immensely important role in storm protection, sand extractors have already removed most of the dunes along

the north coast. Further removal should be prohibited. Public action should assure that sand for the construction industry is available from alternative sources such as importation or sand manufacturing.

The dunes are in a state of constant erosion and deposition. Therefore, no buildings should be constructed on coastal dunes because they may not be structurally stable and because they may adversely affect the natural movement of sand by wind and waves. It may also be desirable to regulate the intensity of traffic (foot or wheeled) on the seaward or windward side of some dunes because such usage can facilitate erosion. (See Report of Subcommittee on Research and Development, "Sand Extraction".)

Recommendation

Puerto Rico should, by regulation, require the preservation of all remaining dunes, both in and behind the maritime zone, as protection against action of the sea.

Views of the Sea

New requirements and incentives are needed to protect views of the sea. A number of steps are possible. For example, beautification funds, the so-called "3 percent money" available for federally-aided

highways, could be used to buy scenic easements along the sea.

Regulations could require separation between buildings along the coast. In appropriate locations, there might also be encouragement to open up the ground floor of buildings so that passers-by could see through to the sea. Signs visible from the sea or from the maritime zone should be restricted by regulation.

Recommendation

New requirements and incentives should be established to protect views of the sea. (See similar recommendation by Recreation Subcommittee.)

Subdivision of Shorefront Property

At present, the Planning Board does not have the power to control land subdivision in projects where each resulting lot has an area of 5 acres or more and is to be used for agriculture. In practice, subdivision into 5-acre tracts normally has substantial impact on the future development of coastal areas. This is particularly true if lots are very narrow and deep, but it is true in any case because of the ease of subdivision into smaller tracts. Given the importance of coastal areas, all land division there, regardless the size of the lots, should be controlled.

Recommendation

The Government should, by statute, extend subdivision control authority to include every division of land located in whole or in part, within 1,000 meters of the sea.

Beach Cleaning

Except in certain beach areas operated by the Public Parks and Recreation Administration, trash pick-up from beaches is rarely adequate. The inadequacy appears to be caused by a combination of lack of funds, inter-agency jurisdictional disputes, and hesitancy to experiment with beach cleaning machines. None of these obstacles seems insurmountable.

Recommendation

The Legislature should allocate sufficient funds for beach cleaning and should direct an appropriate agency to clean the beaches in the most effective way available. (See similar recommendation by Recreation Subcommittee.)

PROTECTION OF COASTAL WATERS

The policy of natural preservation, already recommended for shorelands, should be applied equally to coastal waters. Pollution

and reef disruption can destroy the coastal zone even more insidiously, because less obviously, than misplaced highways and refineries and condominiums.

This report gives only abbreviated treatment to protection of coastal waters, because many of the principal problems are within the charge of other Subcommittees. Furthermore, and possibly more important, the Government is now doing a relatively better job in responding to coastal water problems than to shoreland problems.

The last three years have seen new public concern and involvement with "water problems," new administrative agencies (notably the Environmental Quality Board and the Department of Natural Resources), and vastly increased funding, both from Commonwealth appropriations and Federal aid, particularly for waste water treatment facilities. As a result, although many programs and projects are still too new to evaluate thoroughly, the Government seems to be using a fairly large fraction of its real opportunities to deal with water problems. There is need to do much more, of course. There is need to work faster and more effectively. There is also particular need to recognize that the measures undertaken so far are mostly interim measures and that more far-reaching efforts will be necessary in the future. Nevertheless, the contrast with the shoreland problem is sharp. There, the need is for an almost complete change of direction in dealing with an alarming situation of which

the public is insufficiently aware. Here, in dealing with coastal water, the Government is, by and large, on the right track. The posture of the Subcommittee is basically one of endorsing what is already being done and urging faster and more effective action in the directions already established.

Water Quality Standards

The waters of the coastal zone are, simultaneously, a place for swimming and water sports, the edge of the world's largest remaining wilderness, and the place we dump our waterborne wastes. Wise use is therefore essential.

As soon as possible, the Government should adopt a policy of recovering and reusing all waterborne wastes instead of dumping them into the sea. Nothing less will be ultimately satisfactory either from the standpoint of pollution or from that of resource conservation. For the time being, given the vast gap between that ideal and present practices, a number of lesser steps are valuable. The following needs seem clear:

1. Stronger regulations limiting pollution. For new installations, legislation pending in Congress seems likely to require the use of the best available technology to control pollution. Puerto Rico's regulations, currently being revised, should establish this requirement without waiting for the Federal initiative. In the

case of existing installations violating standards, the Government should establish clean-up schedules like those already being established for air polluters. The schedules should assure that all waters will comply with standards by 1976 or 1977.

2. Pretreatment standards. Waste water treatment facilities are necessarily designed to handle only certain kinds of wastes. Existing regulations should be reviewed to assure that they require whatever pretreatment is necessary so that facilities do not receive wastes they cannot process. If toxic wastes are not amenable either to treatment or pretreatment, new installations producing those wastes should not be permitted in Puerto Rico.

3. An Island-wide plan for waste-water-treatment facilities. Such a plan is scheduled for completion in time to meet a Federal deadline in mid-1973. As now envisaged, the plan will call for "secondary treatment equivalent," which means primary treatment (essentially the removal of solids) plus disposal of effluent through long ocean outfalls. Several regional plants are being planned each with its own outfall.

The Subcommittee considers this ocean disposal acceptable only as an interim step, ultimately to be replaced by recovery and reuse systems. Even within this interim time frame, the Subcommittee believes that no final decision with respect to distribution and location of plants or their treatment processes should be taken without

careful evaluation of alternatives. One alternative that should be thoroughly explored is the establishment of a single collection system, treatment plant, and outfall to serve the entire Island. Processes such as land disposal with indirect reuse should also be considered.

4. More effective control of river mouth pollution. A great deal of coastal pollution is carried by rivers. One needed step to combat this is more effective control of the pesticides used in agriculture. Another is exploration of replacements for septic tanks and privies along streams in rural areas. Still another is adoption of strict grading and earthmoving regulations to reduce erosion and sedimentation.

5. A Puerto Rican oil spill contingency plan. The Coast Guard has a national oil spill contingency plan, supplemented by a regional plan of the Environmental Protection Agency and a Puerto Rican plan. The Puerto Rican plan should be revised and updated to provide detailed guidance, establishing who will do what when oil is spilled.

6. Control of underwater oil wells. Oil prospecting is currently going on along the southern coast of Puerto Rico, and recent announcements indicate that oil extraction may prove commercially feasible. Safeguards are needed to assure that any permitted extraction does not cause damage to the coastal zone and marine resources, as occurred in Santa Barbara, California, and elsewhere. The

opportunity to establish such safeguards should be seized now, before final royalty arrangements and other terms of extraction are established by the Commonwealth Government.

Recommendations

1. The Government should establish a policy, to become effective as soon as practicable, of recovering and reusing all waterborne wastes. Until implementation of that policy becomes economically and technologically feasible, measures to reduce pollution should be vigorously pursued.
2. The oil spill contingency plan should be revised and updated to provide for immediate and coordinated action.
3. Environmental regulations for oil production and transportation should be established prior to signing royalty contracts.

Protection of Coral and Underwater Life

Coral reefs are particular treasures, not only for themselves, but because they provide habitat for a rich variety of underwater life. Damage to reefs is, for all practical purposes, irreparable.

A prohibition against the taking of coral is clearly needed. A further prohibition against sale of coral, would remove one present reason for widespread coral cutting. To aid in enforcement,

transportation and possession of coral should also be regulated.

Recommendation

The Government should, by statute, prohibit the taking and sale of coral and regulate its transportation and possession. (See similar recommendation by Recreation Subcommittee.)

Protection of Ancient Shipwrecks

Some of the treasures found in coastal waters are historical and cultural rather than natural. Of the 116 shipwrecks known to lie around the Island, a number are relics which form an important part of the Puerto Rican heritage.

For a forthcoming Marine Atlas of Puerto Rico, these wrecks were documented by the Department of Marine Sciences, University of Puerto Rico, Mayaguez. The Department discovered that some wrecks--notably a double wreck at Gallardo Bank--had been salvaged and stolen.

Immediate protection of these wrecks is needed, followed by longer term measures to protect the most important ones. The Institute of Puerto Rican Culture and the University of Puerto Rico, among other entities, should play a major role in this preservation effort.

Recommendation

The Government, acting by Executive Order of the Governor or other expeditious method, should designate shipwrecks in Puerto Rican waters as national relics and should prohibit their salvaging or disturbance without permission. A mechanism to classify wrecks, to grant salvaging permits for unimportant ones, and to provide the most appropriate protection for historic ones, should simultaneously be established.

PUBLIC INFORMATION AND INVOLVEMENT

To achieve effective coastal zone management, private citizens and groups must be enabled and encouraged to participate actively in the management process. Although Government agencies must bear major responsibility for the process, they cannot be successful without public information and active day-to-day involvement. Indeed, the importance of public pressure, to counteract the private pressures that every agency head encounters daily, can hardly be overemphasized.

Information Mechanisms

Absence of information about what is happening in government is one of the key barriers to active citizen participation in

coastal-zone management today. As in other subject areas, legislative action can significantly enlarge the citizen's opportunity to participate.

Puerto Rican and Federal laws already require public hearings prior to some major decisions affecting coastal zones. Moreover, Puerto Rican agencies sometimes hold additional hearings voluntarily. Nevertheless, some large coastal projects have been approved without any public notice or hearing. To give meaning to the hearings, all relevant material on the proposed decision, including an environmental impact statement, should be made available prior to the hearings.

Recommendations

1. The Government should, by statute, establish requirements similar to those of the Federal Freedom of Information Act. Until such legislation becomes effective, agencies should establish their own Freedom of Information policies authorizing release of certain classes of information without specific authorization.

2. The Government should, by statute, prohibit secret meetings of public boards and agencies that adopt or apply regulations affecting the coastal zone. *

* Florida's "Sunshine Law" (Section 286.011, Florida Statutes, adopted in 1967) might serve as a starting point for Legislative drafting.

3. The Government should, by statute, require the holding of public hearings (or, at minimum, require public notice plus opportunity for hearing) before public decisions significantly affecting development in coastal zones. Such decisions should include (1) approvals, tentative or final, of major development projects in the coastal zone; (2) plans (or, in the absence of plans, individual projects) involving either the development of public recreational or open space lands or their transfer for other uses.

Public Education and Awareness

Lack of information about natural processes appears to be a fairly direct cause of significant environmental damage. Interviews with fishermen have shown, for example, that many believe that a piece of cut coral will grow back in two months. In other cases, lack of concern is the cause of damage. (It must be presumed that boat owners know what happens when they discard beer cans in skin diving areas.) In any case, educational programs are needed.

Recommendation

The Government should augment existing educational programs by establishing special programs for the groups most responsible

for damages to mangroves and reefs. These groups include fishermen, boat owners, and scuba divers.

In addition to formal instruction programs, there is need for cooperative programs to achieve educational objectives and help implement public programs. One example of such a program in Puerto Rico is the recently funded Project MATE, which calls for high school students to measure rainfall in numerous locations for the purpose of obtaining information on microclimate.

The State of Wisconsin had notable success during the 1960's in securing public participation in formulation of an inventory of important natural, cultural, and historic features. The immediate result was a more thorough and well-evaluated inventory. The longer-term result was public awareness of the existence and importance of the features, with resulting public interest in measures to assure their protection.

Recommendation

Direct public participation should be an integral part of the formulation of an inventory of important natural areas.

New Institutions for Public Involvement

If the coastal-zone-management program is successful, a growing proportion of Puerto Ricans will become aware of their personal relationship to a larger natural environment. Indeed, it seems unlikely that the program can be successful unless this awareness is cultivated. The sensitivity and concern required for preservation of natural features must, in the last analysis, come from within. Regulations alone, even with an army of enforcers, cannot prevent all taking of coral, disruption of mangroves, and so on. Cultivation of the essential concern can best be achieved, it appears, by giving citizens a genuine role to play in the protection of natural areas.

Regional Committees of Trustees

Regional Committees of Trustees appear to be the most suitable vehicle for cultivation of this concern. The committees might perform such roles as (1) conducting continuing environmental inventories (e.g., annual photographic surveys of mangroves, such as the survey recently conducted of Jobos Bay mangroves by the Natural History Society), (2) recommending changes in the boundaries of Critical Environmental Areas, and (3) coastal vigilance for the purpose of alerting Government agencies to the presence

of squatters, fish kills, and so on. The committees should be encouraged to work at municipal level, particularly in those municipalities that establish environmental commissions. When possible the committees should have full-time staff assistance from an appropriate agency as well as a small annual budget, which they could augment by securing local contributions.

Recommendation

Regional "Committees of Trustees," composed of local residents, should be established by regulation or statute, to maintain vigilance over the coastal zone, with special emphasis on shorelands and Critical Environmental Areas.

Culebra Park District

A special opportunity for citizen involvement may exist in Culebra. Partly because the Navy's presence there has slowed development, the island's impressive reefs and other natural features have been preserved better than many similar features in Puerto Rico. Now that the Navy is reducing its role (as demonstrated by President Nixon's recent order relinquishing Navy jurisdiction over island waters), Culebra faces increasing development pressures. These are, for it, virtually a new problem.

In coping with this new problem, Culebra has some special advantages. First of all, it can benefit from the experience of Puerto Rico and other areas that have faced the same pressures for many years. Secondly, its outstanding off-shore keys are an established National Wildlife Refuge, and many are owned by the Puerto Rican Government. A third advantage stems from Culebra's relatively high visibility. The people of Culebra have, as the result of events in recent years, some experience of success in taking local action to cope with local problems. In addition, the Island has received a great deal of attention in Puerto Rico, in the United States, and beyond. As a result, naturalists and other professionals seem especially likely to be willing to assist a Culebran effort to preserve its outstanding natural features.

In sum, if the right catalysts can be provided, Culebra appears to have special opportunity to guide its development without, in the process, witnessing the destruction of the natural features that have, until now, been fortuitously preserved.

To capitalize on these opportunities, the Government should consider creation of a Culebra Park District with power to establish specific development controls, over public and private property, analogous to those established by the U.S. National Park Service in areas such as the Cape Cod National Seashore. The statute might transfer custody of offshore keys to the Districts and express the

policy of the Commonwealth that management of any Federal lands released in Culebra be the responsibility of the District. The statute should assure representation by Culebrans, perhaps by providing that at least half of the District's governing body be elected by Culebra residents.

Recommendation

The legislature should consider the feasibility and desirability of establishing a Culebra Park District, which would have special powers to protect the environment of the Island, and which would include representatives of its residents. The possibility of establishing a similar mechanism for Vieques should also be considered.

Note from the Subcommittee Chairman:

On behalf of the Subcommittee on Coastal Zone Management and myself, I want to emphasize the large debt we owe to Jack Noble, our Vice Chairman, who virtually single-handedly structured this report and worked most assiduously to fill it in.

SECTION 4 -- REPORT OF SUBCOMMITTEE ON
RESEARCH AND DEVELOPMENT

INTRODUCTION

The economy of Puerto Rico has undergone a phenomenal growth that will in all probability continue in the foreseeable future. Our Island now is sixth among nations of the world in value of products and services obtained per unit of active land. It has become, because of this exceptional technical progress, a model for other developing countries. However, much remains to be done in fulfilling the promise of Puerto Rico--particularly with regard to wise utilization of the marine resources that surround this oceanic Island.

Puerto Rico's success has in large measure resulted from a rapid influx of technological knowledge and capital. Needless to say, future development will depend upon our ability to avoid the undesirable consequences that inappropriate applications of technology could have on our society and its environment.

Effective utilization of technology implies: (1) the analysis of all variables involved in the process of economic development of the Island, including a detailed knowledge of the environment that might be affected; (2) the ability to adapt already existing technology to that environment; (3) the development of new technology

that is specifically geared to that environment (in our case, a tropical environment); (4) the development of manpower necessary to work with that technology; and (5) a public that is aware of the available resources, how these may be wisely used, and their limitations.

Technological development in Puerto Rico, particularly because of the Island's high population density, has been placing ever increasing stress upon the shores and surrounding oceanic environment. The problems arising are visible and widely known, yet the knowledge available for their solution is still largely unknown. Comprehensive data on most aspects of the marine environment are required for this problem-solving effort. While some information does exist on water depths, current patterns and other physical, chemical, and biological characteristics, what is available is inadequate to supply answers to most present needs. Data that do exist are deposited in scattered locations. There is no program established to bring this information into a center where it could be available to investigators.

Many specific problems of the marine environment in Puerto Rico require urgent attention. The potential effects of today's practices of dumping industrial and residential wastes, of shoreline and submarine extraction of sand, of dredging, and of thermal

pollution--on organisms and environmental systems in the nearshore waters and littoral zone are not fully understood. There are many indications that these practices do permanent damage to the ocean system surrounding the Island. Many of these practices are not inadmissible; in fact, some are necessary to the life of the Island. But they can only be intelligently carried out in a controlled and managed program that depends upon a thorough knowledge of the marine environment by responsible governing bodies.

While data have been gathered and scientific papers published on the special characteristics and dynamics of tropical marine ecology, many by our own academic institutions in Puerto Rico, there has been no attempt to consolidate this information into an over-all research program to determine the assets, best use, and possible fate of our coastal resources under the pressure of over-population and industrialization.

Today, while we have a vague idea of where our best coral reefs are, we have no over-all knowledge of the extent of these reef communities, their physiological conditions, how productive they are, and the local physical and chemical environments necessary to sustain them. Not even in La Parguera, where the Island has maintained a vigorous marine laboratory for many years, do we have records of extensive water-monitoring, despite the known,

steadily growing impact of pollution in the vicinity of this beautiful and productive coastal sector of the Island.

Coordinated effort in the Island's marine-oriented research and development has become essential. The danger of correcting one problem only to create and intensify another can be reduced only by recognizing the environment as a whole and through understanding the interrelationship of its several parts. A unifying concept is needed if the approach to specific problems is to be most effective.

The wide spectrum of marine environmental problems and the general lack of detailed and comprehensive data call for a broad program of immediate research. Such research would enable us to determine the quantity and quality of our major coastal ecosystems, and the physical and chemical influences to which they are exposed. Some of the prevailing information gaps are now being filled by government programs or by localized requirements for environmental impact statements. However, an ordered program with established priorities in research must accompany this ad-hoc work before we can be effective in planning and managing our marine environment.

Research, and the concomittant development that often follows it (or may even precede it in certain areas) cannot, within the

context of Puerto Rico and its special problems, be readily classified into basic and applied research. In the small technological and scientific community that exists on the Island, this division is artificial and limiting, and it is virtually impossible, nor even desirable, to draw a boundary line and attempt to allocate effort and funds accordingly. Studies of ocean currents and beach erosion, for example, are of more than academic value. At the other extreme, effort toward developing new ocean-engineering devices could very well produce important data for ecologists and biologists.

Puerto Rico has sufficient human resources to carry out needed research, and to develop technology geared to the most desirable utilization of its tropical marine resources. However, necessary funds for this effort are in most instances unavailable. This is a result of our local Government's allocating only limited funds to these endeavors--particularly to the Island's institutes of higher learning --while Federal agencies, which could support this work, establish their priorities according to continental standards.

MAJOR PROBLEM AREAS

Five important areas of research in the marine environment deserve immediate attention:

1. The broad problem of environmental characterization.
2. Beach erosion due to sand extraction.

3. Man-imposed pollution of the marine environment.
4. The immediate need for an ocean resources data bank.
5. The need for specialized education and training.

Environmental Characterization

In reviewing all of the many project ideas put forth by members, all generally agreed that we do not have sufficient information regarding any tropical marine community to allow us to speak intelligently about its fate in the face of the environmental stresses we are imposing upon it today. Thus, it was generally agreed that there is an urgent need for studies of natural marine communities including: mangroves, pelagic communities, coral reefs, eel-grass beds and rocky shore communities.

It is necessary to determine how these marine communities respond to changes in environmental parameters, including, for example, changes in sediment concentration or water temperature. In this connection, it is well to note that tropical marine organisms are generally much more sensitive to alteration of their environment than are their counterparts in temperate zones.

Other investigations are needed before we can estimate the spatial distribution of pollutants (thermal or other) discharged at a given place, rate and concentration.

Although it is believed that currents along the north and south coasts generally flow from east to west as a result of the influence of the North Equatorial Current, recent results show that there are important local exceptions to this.

Marine Biological Inventory of the Shelf

In order to be able to manage our marine resources, intelligently orient our coastal development, properly manage our industries, power plants and outfalls, determine the best public recreational areas, sanctuaries, buffer zones between these and industrial areas, we must be fully aware of the assets of our coastal resources.

At present we are unable to evaluate what we have lost from our marine communities because we have never acquired sufficient and comprehensive knowledge of the resources that existed. Attempts to establish regulations and controls to minimize the degradation of these resources have forced us to adopt Federal standards on pollution levels without fully understanding their application to tropical marine communities. Only after determining the extent of our major marine ecosystems, namely mangroves, *Thalassia* beds, and coral reefs, with adequate background data of the physical and chemical parameters influencing them, can we then determine their response to environmental change.

Recommendation

A program aimed at measuring the extent and condition of Puerto Rico's major marine communities such as mangrove, Thalassia bed, coral reef should be established.

Comprehensive Current Study

We must be able to predict the fate of pollutants released in our coastal waters. The shallow coastal configuration, wind, tides, high and low pressure centers and other effects have a strong influence on our coastal currents. In a recent study carried out by the Oceanographic Program of the Area of Natural Resources, it was shown that currents at eleven sites around Puerto Rico are extremely complex and variable. Strong eastward currents, shears, and cyclic shifts were observed in many areas.

Recommendation

An intensified current study program should be developed for our coastal waters with the aim of determining the overall current patterns of the Island.

Beach Erosion Due to Sand Extraction

Puerto Rico faces a critical problem in the depletion of readily-accessible sand deposits for use by its construction industry. Large-scale sand extraction operations in beach areas, including removal of most of the sand dunes along the north coast, have created acute erosion problems. As the difficulty and cost of obtaining sand increases, consideration is being given to commercial extraction of sand from submarine deposits. Such proposed operations must be carefully scrutinized, however, because of the possibility of smothering and destroying coral reefs in the vicinity of the operation, and exposing beach areas formerly protected by these reefs to further erosion by surf and longshore currents.

(A detailed report on marine sand resources and the associated shoreline erosion problems is appended to this report.)

Recommendations

1. Legislation should be enacted prohibiting the extraction of sand for commercial purposes from the beach zone.
2. Wardens presently in Public Works Department and authorized to patrol the beach zones should be reorganized and given more power to reduce clandestine sand-extraction operations.
3. An inventory should be made of the submerged deposits of

sand around the Island. (The study should estimate available reserves and the economic feasibility of mining operations.)

Incentives, lines of credit, loans and technical aid should be offered by the Government in an effort to secure additional sand resources. Deposits could be exploited in conjunction with the development of other by-products (gold and silver placers). Construction of final pre-cast concrete products at the site should be considered.

4. A promotion program for the development of submerged deposits of sand should be undertaken.

5. A comprehensive study of all beaches of the Island should be undertaken to determine their present state, optimum potential, protective measures required, and order of priorities for their protection and development. (This study should include consideration of the artificial nourishment of beaches by dredging offshore sand and depositing it on under-nourished beaches.)

Pollution of the Marine Environment

Man-imposed stress on the marine environment is evident in three forms in Puerto Rico: physical, chemical and biological. To date, the most obvious pollutant has been the chemical wastes discharged by industrial plants directly into most of the Island's shallow rivers, or into those bays and harbors where heavy industry has concentrated. Chemical pollution in the form of petroleum-

process wastes has been especially evident in the south coast where the petrochemical industry is located.

A less obvious but perhaps more insidious form of chemical pollutant is related to the heavy use of fertilizers and pesticides. Much of the soil where these agricultural chemicals are applied is quite porous and this fact coupled with the characteristic sporadic heavy rain that falls on most of the Island, results in large amounts of run-off containing entrapped sediments and contaminants.

Clearly there are significant amounts of toxic materials carried out by rivers to the surrounding sea each year. Some of the important trace elements from this outfall are known to accumulate in nearshore fish. But very little is known about the effects these substances may be having on the mangroves, reefs and other important marine ecosystems.

Most of the Island's rivers also carry a heavy load of biological pollution, mainly sanitary wastes, to the sea. A high bacterial load and anaerobic conditions are usual in the bays, lagoons and mangrove areas close to human settlements on the coast, or at the discharge end of rivers downstream of heavily populated areas. A major step is being taken to cope with this problem in the form of a comprehensive ten-year plan to create a system of primary and secondary sanitary waste-treatment facilities throughout the Island. However, this massive amount of partially treated biological waste

must still find its way out to sea and ocean outfalls, which will continue to abound in Puerto Rico unless alternatives to this method of waste disposal are operating.

Increasing efforts in planning, management and pollution abatement by Puerto Rico's Environmental Quality Board suggest that the gross problems of chemical and biological pollution may be controlled by new techniques and sizeable expenditures of money in the years ahead. The problem of physical pollution, mainly in the form of thermal effects, looms, however, as one requiring immediate attention and a high priority in research and development effort.

Energy

Thermal pollution of the marine environment of Puerto Rico is directly tied to the major problem of meeting the Island's burgeoning need for electrical energy. The generating facilities of the Island are increasing in capacity at the astonishing growth rate of over 12 percent each year. These power plants, all at present fossil-fueled, have a conversion efficiency of about 32 percent. This means that large quantities of heat must be carried away by cooling systems, which generally discharge the heat into coastal waters.

Projections made by the Autoridad de las Fuentes Fluviales indicate that by 1982, its generating capability will have grown to 7,500 megawatts, with half of this produced by nuclear power plants. As a result, in ten years we will be pouring 5.8 million gallons of hot chlorinated water into the sea per minute. This is about 2.1 times the flow of water carried by all our rivers. By the year 2000, the flow from the generating plants will have increased to about 10 million gallons of water per minute, if the projections are correct. Unless innovative ways to handle or prevent this enormous threat of thermal pollution are developed, life in the waters surrounding this Island will change significantly.

(Because of the importance of energy in Puerto Rico and the need for a more analytical look at the present energy growth policy, a special report on this subject is appended.)

Recommendation

The Government should develop within the next five years a coherent policy for the use and production of energy.

Pollutant Impact on Marine Life

Pollution standards are aimed to reach a compromise between the need to dispose of waste products and the need to preserve

marine communities. Unless we acquire a thorough knowledge of tolerance levels of biota, we can not establish valid pollution control standards, nor can we predict the fate of marine organisms in coastal waters.

Recommendation

A program of studies should be carried out on a wide array of organisms subject to controlled conditions of pollution, placing emphasis on the sessile ones because these cannot migrate. (These studies should give a high priority to corals in view of the importance of reef structure.)

Contaminant Removal

The effective disposal of waste water effluents from petroleum refineries and petrochemical plants often is a difficult problem because of the large variety of non-degradable organo-sulfur waste compounds.

Recommendation

Efforts now being started to develop bio-degradation processes for petrochemical effluents should be intensified and significantly funded.

Sanitary Waste Recycling

The ability of the ocean front to serve as a dump for Puerto Rico's massively increasing wastewater discharges is highly limited. Furthermore, the Island's growing need for fresh water suggests that reclaiming water rather than disposing of it through offshore dumping may become an imperative. In addition, the biological energy load carried by wastewater could have great value if captured for use in agriculture and other bio-fuel demanding processes.

Recommendation

A pilot research and development program should be started to determine the potential for recycling sanitary wastes through ground filtering processes, and the reclamation of biological constituents through soil rehabilitation.

Ocean Resources Data Bank

Various governmental and private institutions have been engaged for several years in gathering data on our coastal waters. As a result, considerable information is available on Puerto Rico's marine resources. Lack of communication and coordination between these agencies and institutions, however, has heretofore kept much of these

data unavailable to individuals or institutions needing the information. Furthermore, local data gathered by off-Island organizations are often effectively lost to Island users.

Puerto Rico's need to study and use its marine resources is expected to increase sharply in the immediate future. If the existing information situation continues, however, detrimental effects might easily develop such as: (1) duplication of costly programs and data-gathering efforts due to lack of coordination; (2) hindrance of research and development programs through poor knowledge of existing data; (3) long-term planning for the Island's marine resources utilization obstructed by the lack of a unified and comprehensive survey of the oceanographic environment.

It is already apparent that many oceanic data systems are being set up, catalogs being automated, and retrieval mechanisms being used in complete or partial isolation from one another. A governmental organization would do a great service by simply bringing these uncoordinated efforts together in a general data system, which incorporates clearly defined and consistently recognizable retrieval identifiers. With regard to input and output format, uniformity in this centralized or clearing house system would offer the advantage that data could be exchanged in fairly routine fashion. No conventional literature search would have to be made more than once.

Although a data bank is expensive to assemble and maintain, under

proper circumstances it can be remarkably inexpensive to use. If the bank is widely used, the initial and maintenance costs can be considered socially bearable. Whether or not wide usage develops depends, however, on how adequate and precise the initial component retrieval and reduction systems are. Hence, existing facilities should first be effectively used before a long-range, centralized program is made available to the Island. The use of available methods and facilities will save considerable time, money and effort in establishing an adequate data bank.

Recommendation

An Ocean Resources Information Center (ORIC) should be established in Puerto Rico.

This Center would compile in readily retrievable form all available oceanographic information on the Island's coastal waters, following the procedures and guidelines established by the National Oceanographic Data Center (NODC) in Washington, D.C. Specifically, ORIC would:

1. gather from the different Government and private sources all available oceanographic information pertaining to Puerto Rico's coastal waters;

2. classify, file and submit the information to NODC (according to the format established by NODC for computerized storage);
3. distribute all retrieved information from NODC to the private and Government agencies that have submitted their data to the Center;
4. provide Government and private individuals with specific oceanographic data they may from time to time require;
5. compile and distribute among educational institutions and the general public simplified compendiums of oceanographic information.

Education and Training

Marine affairs in Puerto Rico, from an educational point of view, have been overlooked. Almost throughout our educational system, with the exception of the universities, there is no program geared to ocean resources and very little in our instructional material that emphasizes Puerto Rico's special potential as an ocean island.

(A special report on the problems and possibilities of a focused effort to develop public awareness and specific marine-oriented educational and training programs in Puerto Rico is included as Appendix C in this report.)

Recommendation

1. Puerto Rico should support its Department of Education in the implementation of a new marine-oriented program throughout its educational system.
2. Special emphasis should be given to coordinating professional education aspects between the universities and the new Department of Natural Resources.
3. A first priority should be given to developing a new education program in the technician and associate degree level in marine sciences.

OTHER RESEARCH AND DEVELOPMENT NEEDS

Although we have tried to indicate those areas that we believe deserve emphasis for research and development, we could not give an exhaustive list because it would change even while we wrote it. What follows are additions that do not fit into the areas already mentioned. We want to stress, though, that even with these we are only noting a partial list of R & D topics pertinent to the needs of Puerto Rico.

1. Chemical analysis of the sea around Puerto Rico
2. Studies of wave actions and energies

3. Survey of potential for underwater parks in Puerto Rico
(See "Coral Reefs and Mangrove Areas", Report of Subcommittee on Living Resources.)
4. Establish an aquaculture pilot project where the most efficient and promising organisms for marine and fresh water cultivation could be determined, as well as the most efficient methods of culture that will lead to rapid growth rates and higher production of these aquatic forms.
(See "Aquatic Life", Report of Subcommittee on Living Resources.)
 - Survey areas suitable for aquaculture projects.
 - Determine technical feasibility and make marketing study of aquaculture crop potential in Puerto Rico.
 - Identify pathogens affecting aquaculture crops and possible controls.
5. Investigate possibility of using cold water from depth for coolants and aquaculture.
6. Exploration for undersea or ocean bottom heavy metals such as nickel, chromium, copper and manganese; and potential gas/oil sites.
7. Artificial reef programs: economic feasibility study; experimental solid-wastes reef; materials deterioration studies, and reef emplacement project follow-up.

8. Development of basis for a Marine Resources Act with incentives for R & D work.
9. Development of a five-year program on ocean resources management for Puerto Rico and its interrelation with Federal agencies and programs.

Research and development in Puerto Rico has traditionally been rigorously controlled on an institutional basis. The source of research funds has for the most part been Federal and private rather than insular. Grants are generally made on a project basis relating directly to the interests of a particular individual rather than to the specific needs of the Island. Individuals, commercial and industrial organizations, even small educational institutions, rarely have had access to research funds through governmental departmental channels.

Perhaps the crux of the problem stems from the fact that very little money has been earmarked by the Island's legislature specifically for research activities.

Recommendation

The Legislature should appropriate funds specifically dedicated to ocean and marine-oriented research and development.

APPENDIX A

A SPECIAL REPORT ON SAND RESOURCES

The extraordinary economic development of Puerto Rico during the last three decades has drastically upset dynamic equilibrium between the supply and demand of sand in the Island. Our progress can easily be measured in terms of the concrete that has been used for building houses, paving roads, constructing dams, establishing industries, and developing recreational, social and educational institutions. The availability of concrete as a construction material depends directly on the feasibility of extracting our sand resources.

The increase in the consumption of sand brought forth the accelerated depletion of the accessible sources, and the construction industry was forced to develop deposits occurring at distances farther away from the urban centers. Consequently, the price of the commodity rose abruptly. The large-scale extraction operations on the beach zone created acute erosion problems and Puerto Rico began to lose expensive real estate to the sea. At the same time, the Island was losing its beaches, a natural resource of far greater potential than sand for economic income.

As the Government began to limit the extraction from the beaches, the operations were moved to river channels and areas covered by residual sandy soils. The extraction of these deposits

created local soil erosion and sedimentation problems. As the residual sandy soils were strip-mined, bedrock was left exposed on the ground surface; thus, Agricultural soils were eliminated through these poor conservation practices. Some sandy inland areas have been dredged to depths varying from 10 to 40 feet leaving great pools of stagnant water near the Loiza Aldea. The coastal dunes were rapidly removed along most of our northern coast, thereby eliminating most of the natural coastal protection along the shoreline extending from San Juan to Isabela.

Puerto Rico presently faces an acute problem of resource management in order to provide an adequate balance between economic growth and conservation practices. Our beaches must be preserved for recreational and touristic purposes, but our booming construction industry must also be supplied with adequate sources of sand. We must also provide for satisfactory restoration and reclamation of the mined lands because Puerto Rico cannot afford the luxury of wasting the limited available land.

Beach Erosion Problem

Beach erosion is generated either by natural or artificial causes. Beach erosion is caused locally by phenomena or works such as: (1) the world-wide rise in sea level, (2) recent disastrous movements, and (3) removal of the protective barrier reef.

The world-wide rise in sea level is a scientifically accepted fact. A rise of five inches has been measured in Chesapeake Bay between the years 1930 and 1947 (0.003 feet per year). A rise of this nature in Puerto Rico, where the range of tides is only about one foot, could easily initiate a cycle of beach erosion.

Puerto Rico's geomorphic features along its coast show evidence of recent disastrophic movements. The Island has suffered a major tilting in the geologic past. The northeastern and southeastern coast are coastlines of emergence, while the southwestern and northwestern coast are coastlines of submergence. The Island is also located in the earthquake belt of the Caribbean Island Arc and it is proven that during the earthquakes of the 1920's, the sea in the west coast receded. All these changes in the elevation of the land have originated erosional cycles in the beaches.

Poor land management, coastal pollution, dredging and other human activities have developed adverse factors in the water quality in the vicinity of coral reefs.

An unbalance between growth rate of the reef-forming corals and erosion created by wave action, has caused rapid destruction of some coral reefs. A considerable retreat of the shoreline along certain areas of Puerto Rico's northern coast has been documented

from old maps and photographs. These shoreline changes have been attributed to the destruction of the protecting barrier reefs by the devastating attack of swells and hurricane waves.

A retreat of the shoreline is obvious in those areas where lunate embayments have been formed between rocky headland such as Mar Chiquita, Breñas, Condado, and Ensenada de Boca Vieja. These features are typical of our northern coast.

Beach erosion can be caused artificially by the action of man. During the past three decades, man has been responsible for most of our beach erosion problems. The activities of man can be outlined as: (1) reducing the quartz-rich supply of sand by damming most of our major rivers or building some river improvement structures, (2) changing the configuration of the coastline by coastal development such as ports, groins, jetties, revetments, land reclamation projects, etc., (3) changing the configuration of the sea bottom by dredging operations, and (4) removing sand from the beach zone for commercial purposes. The removal of sand from the beach zone has created our worst and most difficult erosion problem.

MARINE SOURCES OF SAND

The two most common sources of sand are the deposits on the shore zone and the offshore deposits. Both of these deposits have

been intensively used in Puerto Rico.

The shore zone has extensive deposits of sand around the Island. The deposits occur in the intertidal zone where the sand grains are deposited by the littoral drift. The beaches vary from narrow strips parallel to the coastline to broad inland deposits of about a kilometer in width (Mediana Beach in Loíza and Levittown beach). Although these deposits were heavily developed in the past, the present extraction is limited to several river mouths. The renewal of sand bar from river deposition must be determined before granting permits. This practice is seldom used to determine the impact of the extractive operation upon the natural environment.

Some large deposits of sand occur in the back beach zone. These are usually found as large coastal dunes and series of continuous ancient beaches. The extraction of sand from the dunes eliminate most of the shore protection (Barceloneta and Isabela Beaches). Although it is possible to extract a portion of the dune without eliminating the coastal protection, the determination of the extraction area and buffer (safety) zone is difficult without conducting detailed geologic studies. Most of the permits granted in the past were approved without these comprehensive studies. The back beach deposits are usually in private land where the Government had no jurisdiction until Law 138 of 1968 was

passed. These deposits are dredged by means of draglines creating ponds or lakes in the private farms. The minded land areas are not being properly reclaimed.

The offshore deposits are classified into: (1) the submerged deposits of the Island shelf, and, (2) the deep sea deposits.

The material available in the deep sea deposits is usually too fine-grained to meet the specifications and is so deep that it is usually not economically feasible to dredge.

The construction industry will be facing a crisis by the end of this century if an adequate supply of sand is not secured within the next two decades. In order to solve the problem, the following measures are recommended:

A. For the Protection of Beaches, Dunes and Shoreline

1. Legislation - A law project should be enacted prohibiting the extraction of sand for commercial purposes from the beach zone.
2. Enforcement - Wardens presently in Public Works Department and authorized to patrol the beach zone should be reorganized and given more power to reduce clandestine sand-extraction operations.

B. Research Needs

1. Inventory of Submerged Deposits - A systematic study of the submerged deposits around the Island of Puerto Rico

should be conducted. The study should estimate the available reserves and the economic feasibility of the minning operations.

2. Development of Submerged Deposits - A promotion program for the development of the submerged deposits should be undertaken. Incentives, lines of credits, loans and technical aid should be offered by the Government. Deposits could be exploited in conjunction with the development of other by-products (gold and silver placers). Construction of final pre-cast concrete products at the site should be considered. The establishment of coastal distribution points from stockpiles should be analyzed to maintain the independent truck owner with a steady supply of raw material.
3. Beach Erosion Study - A comprehensive study of all the beaches of the Island should be undertaken to determine the present conditions of each beach, their optimun potential, protective measures required and the order of priorities. This study should include the artificial nourishment of beaches by dredging offshore and depositing the sand in the under-nourished beaches. Financial aid can be obtained from the Federal Government to restore certain beaches.

Several submerged deposits beneath the coastal waters have been explored by government and private enterprises. No permits have been granted for the dredging of sand for commercial purposes since 1966 due to the possible environmental risks. The explored deposits are:

1. Escollo de Arena, Vieques	46.5 million cu. yds.
2. Bahía Las Cabezas, Fajardo	1.4 million cu. yds.
3. Ensenada Comezón, Río Grande	0.9 million cu. yds.
4. Ensenada Boca Vieja, Cataño	2.5 million cu. yds.
5. Punta Verraco, Guayanilla	6.0 million cu. yds.
6. Punta Cuchara, Ponce	6.4 million cu. yds.
7. Bahía Boquerón, Boquerón	5.7 million cu. yds.
8. Bahía Guanajibo, Mayaguez	5.5 million cu. yds.
9. Bahía Añasco, Añasco	not adequate
10. Submarine Channel Espíritu Santo River	
11. Offshore deposit near Isabela	

The extraction of sand from these deposits could easily provide an adequate supply of sand for the construction industry until the end of the century. However, the impact of the operation upon the environment must be considered specially for those too close to shore. The U.S. Geological Survey is presently conducting marine geologic studies to map these deposits.

The possible alternatives to solve the present situation are:

1. Exploiting the Renewable Beaches

If the amount of material deposited in the beach zone and its migration can be determined, the excess of material could be theoretically removed without causing erosion down-drift from the site. However, this is an expensive solution that requires detailed studies and strict regulatory control.

2. Dredging River Channels

Because most of the major rivers have been dammed and are almost depleted of sand, this solution only serves to delay the crisis for several years.

3. Extraction from Inland Residual Sandy Soils

Because extraction causes a tremendous soil erosion problem when the top soil is completely removed by strip mining practices, this solution could create a worse problem than the beach erosion.

4. Dredging Submerged Deposits

Although dredging submerged deposits is not the ultimate solution to the problem since sand reserves are finite, it solves the immediate problem until the next century.

5. Manufacture of Sand

The ultimate solution to the project is the manufacture of sand. Therefore, efforts to establish inland quarries for the

manufacture of sand-sized materials should be carefully considered by the Government. At present this is an economic problem that could be economically feasible in the future as the price of manufactured sand becomes competitive in the local market. Incentives such as tax exemption, financial assistance, and technical advice should be offered to encourage the manufacture of sand in Puerto Rico.

6. Substitution of Concrete

The substitution of concrete in interior walls and partitions by other construction materials such as wood, plastic, bricks would alleviate the problem in Puerto Rico.

7. Importation of Sand

Sand is being imported from oolitic deposits of the Bahamas, but the physical properties of this material do not always meet our specifications for concrete mixes. The sand is usually too fine, spherical, poorly sorted, and is easily worn down by abrasive action. Blending is generally required to meet grading specifications.

APPENDIX B

A SPECIAL REPORT ON ENERGY AND RELATED PROBLEMS

The production of electrical power in Puerto Rico is placing the marine environment under increasing stresses. At present, over 1.4 millions of gallons of hot water per minute are dumped into our coastal waters by the plants that generate electricity. Projections indicate that by the year 2,000 the amount of hot water dumped into the coastal water will have increased to ten million gallons per minute. Other forms of power also produce pollutants, which are carried to the coastal water by run-off from the land. Needless to say, most of the pollutants are highly toxic to marine life.

We recognize that increasing amounts of power are needed to sustain our growing economy. Therefore, there is a pressing need to develop non-contaminating sources of power. However, we have examined the possibilities of using the power from the tides and from the sun and reached the conclusion that only solar power holds any promise as an alternate source. Nevertheless, it should be pointed out that with present technology one can obtain, at the most, from the sun two or three megawatts of power per square mile.

It seems that it is unlikely that power derived from the sun could be used for industrial purposes. However, small units might

be developed to provide power for individual homes.

The demand for electric energy in Puerto Rico has been increasing at an accelerating rate during the last five years. Averaged over that period, the need for electricity has increased at an annual rate of 14.4 percent. That is, the demand is doubling every five years. This rate of increase is roughly twice that of the mainland United States. Because of our limited territory and high population density, the implications of the increasing demand for electricity in respect to the environmental impact are serious. If we continue this trend, Puerto Rico will have to provide sixteen times its present generating capacity in only 20 years.

Given the present economic and social structure, there is little reason to believe that the predicted demand will significantly lessen. However, providing this sixteen-fold increase in generating capacity will put a massive strain on Puerto Rico's economy and natural resources.

This increase would have effects in different areas and would require decision making on the basic technology to be used in the energy production and in the plants' location. Since we have a limited amount of land and a multiple demand over the same, it is evident that conflicts in the localization of energy production plants will arise.

One of the problems that Puerto Rico is confronting, as are other countries, is that the energy policy has always been implicit, and its objective is directed toward the supply of all the energy demand. This policy does not have negative implications as long as the increase in demand is relatively slow and as long as there are not serious conflicts between the objectives of the energy sector and other sectors, especially those related to maintaining the environmental quality. Recently, the relevant conditions have changed and it has created serious conflicts. Moreover, the cost of combustible and other components of the energy production system has increased dramatically.

Also, the technology of generating conventional electrical energy has reached an upper limit and has established the inescapable alternative of nuclear energy.

For these reasons, it is necessary to establish the basis for new explicit energy policy. It must be optimum to the special conditions of Puerto Rico. The objectives of the analysis of the problem should be:

1. To provide a basis for the establishment of the planning process and the formulation of policy about electrical energy, to deal with the kind of demand for electrical energy in Puerto Rico, and the planning of new sources of energy. An energy policy must

include within their components, all those actions that tend to improve the efficiency in the utilization of electrical energy. This is especially important considering the data that has been given in relation to the increase in energy demand in the last few years.

2. To satisfy Puerto Rico's strong need for more employment, better income, industrial development and consequently, energy. Because it is a small Island with high population density, we find it necessary to provide special attention to the environmental impacts that come from economic activities. The result is that frequently conflicts arise between the demand for and utilization of energy. A study will result in a clearer idea of this aspect and to the possible alternatives that deal with the location of energy plants.

APPENDIX C

A SPECIAL REPORT ON MANPOWER, EDUCATION AND TRAINING

The National Academy of Science in its February, 1967 report, Science and Technology in Support of the Puerto Rican Economy, noticed some prevailing deficiencies in the manpower, educational and training phases in the development of science and technology in Puerto Rico. Today, as we focus our attention to the marine sciences and technologies, we also notice some problems that have to be overcome before we orient any marine program for local implementation. Among such needs we outline the following:

1. To assess the present methods and resources for conservation education at all school levels.
2. Experimental new approaches in curriculum, techniques of instructions and use of facilities, which might bring together science and technical education with the socio-economic realities and needs of the Island is needed.

Some issues to consider are:

1. Should there be local legislation or policies for education in oceanography in Puerto Rico, or should each governmental department make its own?
2. Should there be an Advisory Committee composed of members from all agencies and department heads or should

each department or division have its own?

3. Should there be legislative special-funding for Island-wide education program in oceanography, or should each department separate funds from its annual budget for this purpose?

4. Should a Department of Education Advisory Committee produce curriculum materials on oceanography or should an advisory committee develop curriculum materials in coordination with the Department of Education?

Considering the great needs and demands that will exist if a vigorous program for the full utilization and adequate conservation of the marine resources of Puerto Rico is carried out, we direct our concern toward:

1. Improving the process that stimulates the interest and vocation of our students in the marine sciences and the utilization and conservation of our marine resources.
2. Improving the teaching-learning process in the area of marine resources through our schools. New courses must be designed, training materials must be prepared, and teachers must be trained to carry out this objective.
3. Improving the process by which students with interest and aptitude toward the marine sciences are identified.

Activities such as contests, projects, competitive activities and youth congresses of Puerto Rican and other Caribbean students could be carried out to achieve this objective; and

4. Improving the process that encourages high-school students with interest and aptitude in science to form part of the working groups carrying out research, studies, and projects related to the utilization and conservation of our marine resources in the different private and public institutions and other agencies of the Island.

From an educational point of view, marine aspects in Puerto Rico have been overlooked. Throughout our educational system, except the universities, there is no program geared to ocean resources.

As soon as possible, we must start to develop among our people an awareness of the sea's potential. At present, we are lacking such activities as the dissemination and exchange of information, the training of human resources, and production of materials for teachers and students. Along these lines we can implement the following:

Dissemination and Exchange of Information

1. Use of the television stations, radio programs and editorial division of the Department of Education to provide information

to teachers and students in grades Kindergarten to 12.

2. Use of the facilities of the Computing Center of the Department of Education to create an information bank on marine sciences and the utilization and conservation of marine resources.

3. Establishment of marine laboratories by the Department of Education to show teachers, students and the community in general the implications of the study of the sea for Puerto Rico.

Training of Human Resources

1. Organization of seminars, conferences, workshops, courses with or without credit for teachers and students.

2. Provision of consultant services to schools and colleges.

3. Establishment of graduate courses related to the marine sciences in all colleges and universities to broaden the scientific preparation of teachers.

4. Establishment of marine laboratories for teachers and students of public and private schools.

5. Training of students of high ability to carry out scientific investigations and projects.

6. Greater interaction is needed between primary, secondary, higher education, adult education, industry, commerce and business and newly-emerging vocational education, to develop a good "Puerto Rico and the Sea" educational project.

Production of Materials for Teachers and Students

1. Publication of scientific articles, courses of studies, teacher's guides, teaching units, by the Editorial Division of the Department of Education.
2. Design, production and distribution of films, filmstrips, filmloops, models and other audio-visual materials.

The Government should support its Department of Education on the implementation of new marine-oriented program throughout all its educational system. Emphasis should be given to coordination aspects with the Universities and the Department of Natural Resources. A priority among new educational programs should be the development of the technician and associate degree in marine sciences.

SECTION 5 -- REPORT OF SUBCOMMITTEE ON
INSTITUTIONAL ARRANGEMENTS

INTRODUCTION

Institutional arrangements of the public sector of government should not be conceived as an end in themselves, nor can they be formulated or established in a vacuum. These arrangements must be closely related to the particular social, economic, physical, cultural and political realities of which they are part and to which they should respond.

Under these circumstances the functions of any institutional arrangement should be to provide adequate mechanisms and means by which realities, problems, values, needs and expectations of society can be identified, articulated and harmonized, in order to enable the state to adequately define goals and objectives. The state will then be able to pursue these goals and evaluate its activities within a proper framework.

In the particular case of Puerto Rico, a number of factors should be considered in any attempt to define the institutional arrangements needed: degree of heterogeneity, size of the island, population, openness of the system, existing resource limitations, nature as an island system, social composition, degree of development and modernization, rapid social change, and high degree of systemic complexity.

One of the salient characteristics of the existing institutional arrangements framework in Puerto Rico is the multiplicity of agencies and programs that either directly or indirectly affect the marine environment. Even though most of the governmental agencies in this small eco-system affect our marine resources, the following have in the past exerted stronger or more direct influence over our marine habitat: the Planning Board, the Health Department, the Aqueducts and Sewers Authority, the Water Resources Authority, the Municipalities, the Public Service Commission, the Tourism Development Company, the Department of Agriculture, the Parks and Recreation Administration, the Economic Development Administration, the Public Works Department, the Environmental Quality Board, the Institute of Social Technology, the University of Puerto Rico, Inter-American University and the Puerto Rico Conservation Trust. The Department of Natural Resources, which will begin to operate in 1973, will also deal with marine resources. In addition to these local programs and agencies, a number of federal agencies have an impact on the sector; these include the Federal Institute of Tropical Forestry, the Federal Environmental Protection Agency and the Federal Corps of Engineers.

This situation raises a number of general and specific questions to which we will address ourselves in this report; these are:

1. What is the nature of an island system?
2. What are the functions of planning, research, control, use protection, conservation, development and enforcement with respect to marine resources?
3. What type of institutional and functional arrangements exist or should exist for the definition of public policy in the area of marine resources? In addition, what should that policy be, and how should these policies and programs be conceptualized and initiated.
4. What type of institutional and functional arrangements exist or should exist in order to execute and at the same time evaluate this public policy?
5. What are the functions of the Universities in the development and protection of marine resources and how can there be coordination in what is presently being done in the academic community?
6. What measures are needed in order to institutionalize the efforts that should exist?
7. How can we successfully coordinate the public and private sector and the Universities.
8. How can we develop new forms of citizen participation in order to guarantee the accomplishment of our goals?
9. What is the relation between local, central and federal agencies?

CONCEPTUAL CONSIDERATIONS

Before considering each of the areas mentioned in the preceding paragraph, we understand that it is necessary to first describe briefly what have been the general and specific conceptual elements that have been used in order to identify the issues and problems and formulate our recommendations. In this regard, we feel that one of the greatest needs in the area of institutional arrangements is precisely that of elaborating a conceptual framework that could provide at least four things:

1. Enable us to identify the key or critical characteristics of the system being studied, in this case Puerto Rico. It serves a descriptive function.
2. Provide the means to identify the causal factors with respect to the system's behavior, related to the specific area under study.
3. Assist in identifying the most appropriate means to control and direct the system.
4. Provide a framework within which to formulate objectives for the system. In this sense it has a prescriptive or normative role.

Puerto Rico as a System

Our recommendations have taken into account the peculiarities of Puerto Rico as a system and as an object of policy decisions.

There are four aspects which are relevant for our purposes:

1. The fact that Puerto Rico is an island,
2. its small size,
3. system integration, and
4. system openness.

Even though all four interact to create a specific environment for the formulation of policy we shall treat them separately for purposes of exposition.

The nature of Puerto Rico as an island will not be dealt with in more detail since its implications are clear.

Small Size

1. Definition of size is arbitrary and relative since there are many criteria that can be used to establish size: geographic area, market size, population, and others. Depending on which criteria you use, Puerto Rico can be small for some purposes, but large for others.

2. For our purposes, the significant criterion is a combination

of a large population within a small geographic area. The problem is one of extreme pressures on our environment and limited resources to withstand these pressures.

3. In small islands, the problem of capacity constraints is one that has to be dealt with explicitly. In this regard, we must first determine the bearing capacity of the system, not only with respect to economic activities and population but also with respect to the assimilation of wastes. The smaller the capacity of the system the greater the likelihood that the sea becomes a dump.

4. Since there is less diversity in the ecological systems, small size also implies vulnerability and reduced margins to withstand the results of environmentally damaging decisions or market failure.

System Integration

1. The smaller the system, cet. par., the more integrated its components; the more difficult it is to separate them into independently acting units. Although it might be advisable to do this for functional purposes, it is difficult to segregate one component, for example, the coastal zone from the rest of the system.

2. A highly integrated system is characterized by the existence of spillovers, which may be of a geographic or sectoral nature, in the decisions made.

3. Interrelationships between components may manifest themselves as conflicts or may represent complementary behavior. For example, large-scale projects such as PR-52 and Toa Vaca will probably have island-wide effects which should have been considered in the planning stages.

4. Small scale, together with system integration, reduce the degrees of freedom for sub-optimization or for the possibilities of market failure, since impacts will be island-wide.

5. The more complex the system becomes in terms of the number of components in it and their interrelationships, the more difficult the planning and policy-making functions become.

System Openness

Up to now we have dealt with Puerto Rico as a closed system with a fixed amount of resources, limited capacity and other defining characteristics. This characterization as a closed system is a result of the fact that we generally consider that environmental impacts or linkages almost always remain within the system. However, for a number of reasons we could also classify Puerto Rico as an open system:

1. An open system is one that depends on flows between itself and its external environment for survival. These flows may include

exports and imports, capital and technology, population movements, information and others.

2. These flows determine the structure of the system in many ways. They are causal factors. This is true with respect to the economy, as well as other areas.

3. In terms of our Subcommittee's task, the importation of technology acquires great importance, since it is technology which is being singled out with more and more frequency as a determining factor in environmental degradation.

4. System openness also refers to the application here of Federal Government criteria and norms. These are frequently dis-functional with Puerto Rico's characteristics.

5. Economic, as distinct from ecologic, linkages are in most instances extra-systemic.

Our brief analysis of the preceding pages has attempted to point out that there are a number of factors such as small size, system integration and external dependence which have direct bearing on how we treat Puerto Rico. Acting together these various factors have important implications for decision-making. An example will illustrate the point.

Federal minimum wage legislation has affected industrial strategy in Puerto Rico, leading to the establishment of capital-intensive

industries such as petrochemicals and others. These industries have a number of characteristics which are incompatible with our Island's characteristics and environmental objectives:

1. they require large amounts of land,
2. this land must be flat and near the coast,
3. they use large amounts of water and energy,
4. they contribute significantly to air and water pollution.

In this example, the openness of the system, (manifested in the application of Federal criteria and standards), together with small size, creates a very serious problem which should be taken into consideration in the decision-making process. Once a decision is taken with respect to one policy matter, in this case minimum wages, a number of others are affected.

Our Subcommittee has also taken into consideration the fact that Puerto Rico is a transitional society. We have assumed throughout our report that the general and specific characteristics of government bureaucracies in such societies must be taken into consideration by policy-makers.

The fact that Puerto Rico is a transitional society results in tensions which are reflected in conflicting objectives and priorities. This has affected the workings of our bureaucracies, and has resulted in lack of articulation and inaction; the lack of fiscal resources;

limited technological capacities of its personnel; a paternalistic approach to problems and solutions; the displacement of social objectives by these bureaucracies; the lack of relevant information; the tendency to solve problems with the creation of new agencies and programs, tendency to see in more centralization, better planning and more efficient supervision, thus seeing in centralization a solution to government problems.

These considerations have the following specific implications for our marine environment:

1. The problems related to marine affairs will not be solved merely by recommending new policies, priorities and structures. This approach would ignore the fact that decisions on public affairs are part of the general dynamics of politics. We must not import models from other nations without considering the nature of our political realities and our society. It would be superficial to use criteria and policy models not functional with and relevant to our general environment.

2. To the extent possible, we should not create new agencies but should rely on existing organisms. This entails some difficulties, including those related to changing the objectives of already established bodies. The creation of new agencies to fulfill or carry out newly defined functions also implies serious drawbacks that impede action. In other words, we should avoid the pitfall of creating

new entities to control or coordinate existing bureaucracies.

It is not enough to propose a list of new programs and institutional arrangements. Priorities should also be defined, trade-offs considered, the cost of proposals estimated, and long-range and short-range proposals differentiated.

3. Under some circumstances, structural redundancy and duplication are advantageous.

4. Efforts should be made to promote citizen awareness and participation through the development or organization of voluntary citizen associations.

5. Although there should be centralized financing, means should be provided for obtaining funding from several sources and channeling them to individual units in government.

6. Institutional arrangements should facilitate and promote innovation and change, and avoid traditional practices and concepts which have paralyzing effects.

7. Relevant research of an inter-disciplinary nature should be promoted, and maximum use of the research facilities already existing in our Universities should be made. Research aimed at developing adequate methodologies for dealing with the specific needs of Puerto Rico should be given high priority. The general objectives and considerations have been translated into more specific recommendations. These will be summarized under four major categories: Social

Awareness, Information and Education; the Policy Formulation Process;
Intelligence and Research; Development, Use Regulation and Conser-
vation. Finally, we have attempted to define the functions that
should be assigned to the new Department of Natural Resources.

SOCIAL AWARENESS, INFORMATION AND EDUCATION

Over the past twenty years Puerto Rico has been primarily concerned with the urgent need to develop its economy, and modernize its institutions and has adopted strategies aimed at developing the appropriate attitudes in society for this endeavor. As a result, the Government's aims of economic development and industrialization have become society's. Just as in time of war it is those sentiments which dominate the value structure of society, the values developed in Puerto Rico have been closely related to economic growth. The constant repudiation of traditional values and activities, the insistence on modernization and association with prevailing life-styles in the United States have led to an excessive emphasis on consumption, so that our present consumption patterns are similar to those of the United States even though our income levels are substantially below those of that country. The emphasis on consumption and industrialization has not permitted the creation of awareness of the problems related to environmental quality, balanced growth and others.

We understand that the role of government should not be limited to responding to the pressures which arise from the above considerations, but that should also assume a leadership role with respect to modifying values and emphasizing considerations related to long-range or future concern. Government should help in the articulation of values and concerns which are not generalized.

Obviously, preoccupation with the need to develop and preserve the marine habitat, is one important area of concern. There are many ways in which marine problems could be tackled. One, of course, is through the traditional mechanism of education, but there are others.

Recommendations

1. The Government should start public information programs related to the marine environment through WIPR-TV and Radio, aimed at generating interest in our marine habitat in our population.

(See also similar recommendations in reports of Subcommittee on Recreation, and on Research and Development.)

2. The Governor's message on Environmental Quality to the Legislature should single out marine affairs as an area of special concern. This message would serve not only to inform, but also to emphasize the marine area as one in which there is special interest and which offers special opportunities.

3. Courses and course materials on marine affairs should be developed in the elementary and secondary grades in the public schools. The Department of Education should ask experts in this area to prepare texts to be used throughout the public school system.

(See similar recommendation in report of Subcommittee on Research and Development).

4. The Environmental Quality Board and the new Department of Natural Resources should establish aggressive programs of public information in the area of marine affairs. They should promote and facilitate the work of citizens' groups already active in the area of conservation and environmental quality by opening their doors to interested citizens.

5. The Conservation Trust Fund should concentrate its efforts and resources in the area of education and information and should coordinate its activities in this area with the University of Puerto Rico.

6. Local participation in Federal programs related to the marine environment should be augmented, as should exchanges between Puerto Rico and the United States in order to improve understanding of the Island's needs on the part of Federal officials.

7. Puerto Rico should actively participate in international organizations and associations particularly within the Caribbean, in those activities which will improve the understanding of the Island's

needs vis-a-vis other countries' needs. ((See similar recommendation in report of Subcommittee in Role of Puerto Rico in the Caribbean Sea).

One very important problem with which we are faced is the fact that, in spite of the existence of the Marine Sciences program at the University of Puerto Rico in Mayaguez, expertise in the area of marine affairs is frequently not available in Puerto Rico. We understand that the problem is not only one of creating scientists, but also of generating the expertise necessary to formulate and carry out policy, as well as the creation of technical capabilities in specific areas related to the marine environment such as, fishing, aquaculture, and others; and development management capabilities in the area. This is probably due to the fact that our universities have responded slowly to the changing societal needs of the Island. Although this phenomenon is not unique to Puerto Rico, our universities have often developed programs and areas of emphasis which have little relevance to Puerto Rican concerns at any one moment. In this regard we should make universities responsive to these needs without impinging on their nature as autonomous institutions.

In some areas related to the marine environment some important beginnings have been made in Puerto Rico, which should be supported and endorsed by the Government, the University and the community. We refer to the Marine Sciences program at the Mayaguez Campus of

the University of Puerto Rico, the proposed fishing school in the Aguadilla Regional College and the programs dealing with aquaculture in Mayaguez. The Subcommittee endorses these programs, particularly the Marine Sciences' program, which in many ways provides the foundation.

Recommendations

1. A Master's level program should be created at the University of Puerto Rico in Environmental Management with emphasis on policy analysis, one of whose areas of concern would be the marine environment. (This program would make use of existing programs at U.P.R. in the natural sciences, planning, public administration, law and management. It would be interdisciplinary and would not require the establishment of new academic structures.)

2. A Bachelor level program on marine affairs should be developed at the University of Puerto Rico with the collaboration of the Environmental Quality Board and the Department of Natural Resources.

3. The University should also offer short courses and seminars in the area of marine affairs for high and middle level government officials. (It is important that Federal officials participate in these courses so that they may become aware of Puerto Rican needs and realities. The Conservation Trust Fund should also participate

in the development of these programs by providing some financial support.)

Another important area of concern not only in marine affairs, but also in most of the activities of our Government, stems from the fact that information is frequently not available to citizens and private organizations interested in understanding the relevant issues in order to participate in the decision-making process. In the United States this lack of information led to the adoption of the Freedom of Information Act. Other nations have likewise adopted measures aimed at freeing information from governmental bureaucracies. Puerto Rico has urgently to rectify the present public information with respect to government programs has not been available to citizens.

As a result, participation by citizens has been limited to public hearings in which the subject under discussion has already been dealt with extensively at the agency level. Frequently these hearings only legitimize a decision already taken behind closed doors. All of this is related to the problem lack of governmental awareness of the importance of incorporating the citizenry into the decision-making process. The situation requires prompt and decisive corrective action.

Recommendations

1. Puerto Rico should approve a law similar in objectives and purposes to legislation approved in other countries, particularly in the United States, in order to improve the flow of information to the public. (This law should be part of a more general effort to establish general administrative norms and procedures for all agencies.)

2. Citizen participation in government programs and decision-making should be stimulated as a means of improving the process, and of integrating larger numbers into the sphere of Government. (This principle should be a part of any general administrative norms and procedures established for all agencies. Specific forms of citizen participation are mentioned below.)

3. All government agencies should be required to allow effective citizen participation throughout the decision-making process not only through public hearings but also through advisory committees and other means.

THE POLICY FORMULATION PROCESS

The importance of the policy formulation process is frequently unrecognized in government activities. Policy formulation is frequently confused with the statement of broad general objectives of

a normative nature, not concerned with the establishment of priorities or the development of means of integrating different sectors and programs, nor with costs and implementation mechanisms. Operational programs frequently swallow up the more long-range, somewhat more intangible concerns implied in policy formulation. This is especially true with respect to situations in which an agency encompasses both policy functions and operational activities, as has been the case with the Planning Board.

Another reason for the scant importance given to policy matters is the fact that policy, dealing with intersectoral concerns, is much more difficult to handle. Planners have traditionally dealt with individual sectors, concentrating on what has been termed "single purpose planning". It is not surprising, then, that areas which require inputs from many disciplines and do not adjust to traditional sectoral categories are frequently excluded from the policy formulation process. Needless to say, when we state that there is no policy, what is meant is that there is no explicit policy, since there is always an implicit policy, even if it means disregard of a specific problem area. Given the nature of Puerto Rico as a system, some of the considerations which must be taken into account in the design of the policy-making system are:

1. Planning and policy formulation must be conceived as the means of dealing with the interdependencies mentioned. Decision-

making must be integrated both horizontally and vertically, that is, between sectors (agriculture, industry, transportation, recreation) as well as between levels (Federal, Commonwealth, Municipal).

2. Where the system is highly integrated, the advantages of centralization in the policy-making organs should be considered. Decentralization should be limited, for the most part, to functions related to operational matters. Enforcement activities can usually be decentralized.

3. With respect to industrial location policies, the advantages of concentration in a small, highly integrated system, should be considered.

4. Given the importance of exogenous factors, the Island must improve its external (intelligence) capabilities. This is especially important with respect to technology assessment, given the fact that Puerto Rico imports most of its technology.

5. Public policy must consider the Island's capacity to sustain further economic growth on the same pattern as in the past two decades. Alternatives must be considered which are better suited to Island characteristics in terms of the economic structure proposed.

6. All of the above could be summarized by saying that planning must adopt a total system perspective. Environmental problems will not be resolved unless policies in this area are linked to decisions in other sectors.

In the area of marine affairs there is a critical need to formulate explicit goals and to integrate them into the overall economic and social objectives. At the present time the Environmental Quality Board is responsible for formulating public policy with respect to the environment. However, the present arrangement does not appear to be satisfactory for a number of reasons. For example, objectives related to other areas conflict with environmental goals and the Board is frequently forced to take a defensive position. The responsibilities of the Board need to be clearly established, especially vis-a-vis the Planning Board and the proposed Department of Natural Resources. Each sectoral goal statement should be drafted in a way that attempts to resolve the critical problems related to marine affairs. Our position is that the Environmental Quality Board must be given specific responsibility for policy formulation at the sectoral level.

The foregoing arrangement does not resolve two fundamental problems. One is the necessity for assigning to the Environmental Quality Board the importance it deserves. We are concerned that the new Department of Natural Resources will absorb all the funds for operational functions, and that, as has frequently been the case, the policy making functions will be weakened. This, of course, depends on the Governor's inclinations and the amount of public pressure brought to bear in this matter.

With respect to the first of these two matters, the Committee is emphatic. With respect to the second, we propose that a concerted effort be made by the Environmental Quality Board to increase citizen awareness and citizen participation in the policy formulation process. Detail recommendations on these aspects will be made below.

The type of policy formulation structure which we consider most desirable for Puerto Rico and which we are proposing in the area of marine affairs would charge the Planning Board with the responsibility for translating the social priorities adopted by the Executive and Legislative branches into more specific operational directives. These would then be transmitted to the different agencies dealing with the various sectors. The Environmental Quality Board should be in charge of formulating the policies for the marine resources sector and the Department of Natural Resources should be responsible for the execution and operation of programs.

Obviously, the various levels should be integrated in order to minimize conflicts. The system cannot be considered as one which is hierarchically structured with respect to information flows, but rather as one in which there is a great deal of feedback. Thus, the Environmental Quality Board could provide inputs to the Planning Board in order to help that agency in the formulation of overall goals and priorities. The Department of Natural Resources would have a similar role in the formulation of sectoral policy.

In order to assure that the policy formulation system will function effectively, it is important to consider the instruments available to deal with the process. At the Planning Board level, the Four Year Plan and the Four Year Program are both potentially useful. There is need for a similar instrument that could serve at the sectoral level, to achieve the required integration between the policy formulation functions of the Environmental Quality Board and the operational activities of the new Department of Natural Resources. Several measures can be suggested:

Recommendations

1. The position of Associate Director for Marine Affairs of the Environmental Quality Board should be created by legislation. His functions would deal with policy recommendations to the Environmental Quality Board on marine affairs, just as the other Associate Directors deal with solid wastes and air and water quality.
2. The Board should be given specific responsibility for preparing a Four Year Development Plan for Marine Resources. This plan, approved by the Environmental Quality Board, would be integrated with the Planning Board's over-all Plan and would provide guidelines for the operational activities of the Department of Natural Resources. Since the Secretary of Natural Resources is a member of the Environ-

mental Quality Board, he would provide the needed integration. The Plan should be the subject of public hearings prior to its approval.

3. Operational activities should be separated from the Planning Board in order to permit it to successfully carry out its policy formulation functions.

4. That an Advisory Council for Marine Affairs be created to advise the Associate Director for Marine Affairs in matters related to the establishment of policy in the area. The Council should be composed of representatives of government and private institutions, as well as individuals involved in research in the area of marine affairs. The Council should also include public-minded individuals with no specific expertise in the area.

INTELLIGENCE OR RESEARCH

If our objective is to improve the Government's capabilities in the formulation of consistent, informed policies in the area of marine resources, research plays a fundamental role. It is true, however, that in Puerto Rico research has played a secondary role. Its importance has not been recognized, even at the universities. Of course, research is not a unique category or one that encompasses a set of homogeneous activities. There are various types of research serving different aims: basic scientific research aimed at discovering previously unknown facts, research related to specific program or project

objectives, and that dealing with policy formulation and evaluative research. To a greater or lesser extent, the various types of research are being carried out in Puerto Rico at different levels and in different institutions. What we visualize is a differentiation of research responsibilities on the basis of the nature of the research and the primary responsibilities of the agencies.

In the area of government-financed research there should be broad policy guidelines to distribute the available funds. Undoubtedly the University will continue to carry out basic research projects as well as more applied research in areas which respond to the faculty's inclinations. It is also true that the Department of Natural Resources will have a research capability, especially in that type of research related to specific programs. Still, we have identified some gaps in the type of research being done and in the existence of mechanisms that would stimulate activities. It is to these gaps that our recommendations are aimed.

Recommendations

1. Policy research should be promoted more intensively, either with the actual institutional arrangements in terms of placing more emphasis in this area, or in terms of creating a new mechanism to carry out such research.

2. The Associate Director for Marine Affairs of the Environmental Quality Board together with the Advisory Council for Marine Affairs should be responsible for setting priorities in government research in the area of marine affairs. These priorities should be based on the overall policy for the sector, and should provide guidelines for the allocation of government funds to research.

3. The University of Puerto Rico should be in charge of handling the Sea Grant Program, but should seek the collaboration of the Environmental Quality Board and the Department of Natural Resources, and other related sectoral institutions.

4. A special projects fund should be established by the Government to be managed by the Environmental Quality Board. This fund would provide seed money for projects which fall outside current sectoral priorities or guidelines.

5. The Legislature should appropriate funds to be used for research of marine affairs by the different agencies involved in this sector. Progress reports on the use of these funds should be made every year to the Governor and the Legislature.

6. A data bank on marine affairs in Mayaguez should be established and present facilities should be reinforced. (See recommendation on Data Bank in Report of the Subcommittee on Research and Development.)

7. More emphasis should be given to maximizing the use of local talent in research projects.

DEVELOPMENT, USE, REGULATION AND CONSERVATION

There are innumerable programs and activities that affect the marine environment. These include recreational activities, exploitation of resources such as sand, research, and many others. These are frequently in conflict with each other. One of the problems that Puerto Rico has faced in the general area in marine affairs is that of enforcement. We visualize enforcement as being directly related to the whole process of formulation of objectives, drafting of regulations and establishment of priorities. The question of effective enforcement depends partly on the clarity with which objectives are stated and the precision with which regulations are written. Still, the problem of enforcement is one which requires immediate action. It is to be hoped that with the creation of the Department of Natural Resources the problems associated with the dispersion of enforcement activities will be remedied, at least partially.

Even though the area of enforcement is one in which citizen participation can be especially productive, in the past, there has been little, if any, interest on the part of the agencies concerned to incorporate the citizenry into its enforcement program. We feel that

it would be particularly productive to establish training programs to enable citizens to participate not only in enforcement programs but also in the policy-making stages of the decision-making process.

There are other problems related to this general topic. One is the absence of any one agency dealing with the problems related to the development of resources. In the field of marine resources it is especially urgent that the development functions be defined. The Department of Natural Resources should be primarily responsible with the development of our natural resources according to the policies formulated by the Environmental Quality Board.

Recommendations

1. Municipal citizen groups should be established to deal with problems of conservation and enforcement in the area of marine resources. These groups should be established with the collaboration of the Environmental Quality Board and the Department of Natural Resources. Budgetary appropriations should be made available for the training and organization of these groups. (See similar recommendation in Report of the Subcommittee on Coastal Zone Management.)

2. It should be clearly established that primary responsibility for the drafting of regulations in the marine resources sector correspond to the Environmental Quality Board, although the participation

of the Department of Natural Resources is necessary in the process.
The incorporation of the citizenry in the policy-making process
should be of immediate concern to government officials. In this
regard a preliminary step could well be the establishment of advisory
citizen committees on an ad hoc basis to help in the process of draft-
ing adequate regulations. These citizen advisory committees and the
other groups working within the agencies should reflect a wide variety
of economic or social characteristics.

3. Since there are a number of areas of critical importance,
the Planning Board and the Environmental Quality Board should identify
these Critical Environment Areas and specific policies should be de-
lineated for them. Again, this is an area in which ad hoc citizen
groups can fruitfully participate. (See the section on Critical
Environmental Areas in the Report of the Subcommittee on Coastal
Zone Management.)

Other development, use and conservation functions are discussed
in the following section on the Department of Natural Resources.

THE DEPARTMENT OF NATURAL RESOURCES

This Department will begin operations in January, 1973. Because
of its importance, and the fact that the Law which created it did
not specify its functions in general, or as they relate to marine

affairs, we have felt the need to mention briefly what we consider should be the new Department's principal functions.

1. The Department of Natural Resources should be an operational department, and that primary responsibilities for policy formulation should remain in the Environmental Quality Board. Although the law specifically indicates this, it is imperative that this separation of functions be recognized de facto in budget appropriations and by the decision-making process in general, particularly by the Executive Branch.

2. The Environmental Quality Board should have primary responsibility for drafting of regulations in close collaboration with the Department of Natural Resources.

3. With respect to coastal zone management, the Department of Natural Resources should have primary responsibility for all management aspects. The Planning Board will have a number of functions dealing with zoning of special areas, building standards and others. The Environmental Quality Board should deal with those areas having to do with the formulation of overall policy dealing with coastal zone management. However, in the event that Federal legislation is approved with respect to coastal zone management, it may be desirable to create some sort of coordinating mechanism in addition to the existing ones such as the membership of the Secretary of Natural Resources in the Environmental Quality Board. (See similar

recommendation in Report of the Subcommittee on Coastal Zone Management.)

4. The Department of Natural Resources should be in charge of all development activities seeking to stimulate private and public development of marine resources.

5. Programs related to commercial fisheries should be in the Department of Natural Resources.

6. Research related to operational activities and development should be the primary responsibility of the Department of Natural Resources.

7. Promotion and the establishing of incentives for development of marine resources should be the responsibility of the Department of Natural Resources.

8. The enforcement function should also be a responsibility of the Department.

9. The actual development and administration of programs related directly to marine affairs should also be under the direction of the Department.

OTHER ISSUES

In other parts of this report we have emphasized the need for government to promote and stimulate citizen participation at all

levels of governmental action. The "Puerto Rico and the Sea" project is a good example of what citizens can do to help government cope with the problems it faces. Government must undertake a major effort to promote citizen participation at all levels and to act on the recommendations made by citizens committees, implement those which it feels are meritorious and explain why others should not or cannot be implemented. This is a very important aspect of citizen participation, for otherwise the impression is created that citizen participation is merely formalistic. Unless these steps are immediately taken, citizens will continue to feel skeptical about their participation in the decision-making process and the whole concept of citizen participation and involvement will suffer as a result.

Past experience shows a tendency on the part of government to either ignore the citizen recommendations or to neglect to provide the necessary follow-up which we feel is so important. In fact, the recent report rendered by the study team of the Commission on the Reorganization of the Executive Branch, and by the Reorganization Commission itself, pinpointed the need to have adequate follow-up mechanisms:

Critical to the Governor's ability to lead the Government in the direction he decides is his skill in gaining support and approval for his policies both in the legislative and within the policy-making

circles of the Executive Branch. Perhaps even more critical, however, is his ability to ensure timely implementation of these new programs and policies in a form which serves their original objectives and resembles their original concept--a considerable feat in a complicated bureaucracy. It is important that the Governor have the additional capacity to single out those few new programs which hold highest priority and be confident that their designation as "highest priority" will ensure speedy and successful implementation.

Recommendations

1. One year after this report is submitted to the Governor, the Parent Committee of the "Puerto Rico and the Sea" Project should convene so that it can analyze and evaluate what has been done with its recommendations; and re-examine and evaluate its own recommendations.
2. A Special Project Staff Unit for marine affairs should be created in the Office of the Governor to carry out two general functions: analyze and evaluate programs and to see that new programs and policies in marine affairs are implemented.

With regard to the first general function, its specific areas of concern should be:

- a. Identify and appraise stated and actual objectives.
- b. Measure effectiveness in terms of both program results and the important specific problems to which the programs are oriented.
- c. Generate and consider alternative means of achieving program objectives.

With regard to its second general function, its specific areas of concern should be:

- a. Independent monitoring of agencies' performance.
- b. Assistance in the development of a detailed project plan.
- c. See that an implementation schedule is made and accomplished.
- d. Issue regular status reports on progress made.

The Special Projects Staff Unit should be composed of a small cadre of personnel who should be able to communicate on a peer basis with the top levels of government, be sensitive to the workings of bureaucracy and be able to exert leadership.

Similar units should be established at the Environmental Quality Board and the Department of Natural Resources. The outputs of such units must be integrated into the decision-making process of government.

PROCEEDINGS AND ACKNOWLEDGMENTS

The Subcommittee on Institutional Arrangements was composed of a representative group of scholars, government officials and persons from industry, who had shown, in the past, interest and capabilities in the area of natural resources, and on how government should be organized and operated in societies such as Puerto Rico.

The first meetings of the Subcommittee were devoted to the elaboration of a plan of action, and the discussion of the conceptual considerations that should serve as the framework for the task of the Subcommittee. After this initial stage, the Subcommittee decided to hear the testimony of a number of governmental officials and university professors, so as to identify the major areas of concern, the most pressing problems and consider their recommendations. From this process, and on the basis of its own work, the Subcommittee identified the major recommendations. These became, after a process of evaluation, our final conclusions and recommendations.

Over the past few months, progress reports were made to the other Subcommittees and to the Parent Committee; meetings were held between members of our Subcommittee with other Subcommittees and with the Parent Committee. During all of these stages the preliminary findings and recommendations of our Subcommittee were discussed, analyzed and evaluated by other Subcommittees and by the Parent Committee.

In this sense, our findings and recommendations tend to integrate and reflect the findings and recommendations of the other Subcommittees.

This Subcommittee wishes to express its gratitude to the Environmental Quality Board, which provided office space, materials and personnel to help in our task. In particular we wish to acknowledge the help given by Mrs. Carmen Enid García de Cabán, who acted as coordinator and intern, Miss Josefina Santos, who acted as secretary, and other persons of the Board who offered valuable help. We would like to single out its Executive Director, Cruz A. Matos, for his assistance; the Board's administrative official, Carlos Conde, and Miss Yolanda Colón.

We also wish to acknowledge Mr. William Beller's and Miss Margarita Gandía's significant help, and thank all the other persons who directly or indirectly contributed to the task of the Subcommittee.

SECTION 6 -- REPORT OF SUBCOMMITTEE ON
THE ROLE OF PUERTO RICO IN THE CARIBBEAN AREA

INTRODUCTION

The Caribbean Sea should be regarded as a possession common to all of the countries of the area. Recognizing that the sea has but limited resources, it becomes imperative to realize that these should be judiciously exploited and that all area countries must be of a common accord when acting to prevent the misuse or mismanagement of exploitations which could result in the depletion of the sea's bounty. In order to foster the aforementioned realization of the need for judicious exploitation, this Subcommittee will recommend "mechanisms" for cooperation among Caribbean countries.

An analysis of the role that Puerto Rico can play in the Caribbean area requires that these roles be placed in proper perspective within the regional framework as a whole. For this reason the Subcommittee's report has been subdivided into the following topics: first, the present character of the Caribbean area will be briefly discussed, and then the role of Puerto Rico in the Caribbean area will be expounded upon. The final section will contain serial recommendations for cooperation among Caribbean countries.

THE PRESENT CHARACTER OF THE CARIBBEAN AREA

The Caribbean "area" has been understood by this Subcommittee to include the archipelago which is comprised by the Greater and

the Lesser Antilles, and the littoral areas of Central America and northern South America, i.e. Columbia, Venezuela and the three Guyanas.

The area as such understood is characterized by a common history but not necessarily by a common destiny. A common history because of the impact of certain region-wide factors such as a regional colonialism, the slave trade, the persistence of plantation economies and, in the 20th Century, and a general dependency upon restrictive metropolitan cultures and economies.

At the same time, there appears to be no common destiny for a series of reasons, namely:

Political Balkanization

Political structures in each territory have been shaped by their respective metropolitan models such as the French Republican model in the French Antilles, the Westminster model in the English speaking Antilles, the American Republic model in Puerto Rico and the U. S. Virgin Islands, the Dutch model in the Dutch Antilles and Surinam, and the traditional Hispanic model in the other countries.

Inequity of Political and Constitutional Development

Within the "Balkanization" division there has occurred a further serious division between Caribbean societies

marked by a deeply ingrained constitutionalism such as found in the English, French and Dutch Antilles, and those societies marked by the typical Creole and Latin American dictatorships, specifically in Cuba, Santo Domingo, Haiti and Nicaragua. This, in brief, constitutes a serious inequity of Political and Constitutional Development.

Linguistic Divisions

Alongside all of the above there prevails a linguistic division which divides the Caribbean countries into four major language groups: English, French, Spanish and Dutch. This has made cooperation among the area countries, not impossible, but indeed difficult.

Pluralistic Societies

The Caribbean is a pluralistic society composed of an enormous variation of national, cultural and religious groupings which make the growth of effective national citizenship extremely difficult. Guyana, for example, has a society composed of Portuguese, Syrian, Blacks, Indian, Chinese and Amerindian ethnic groups. These groups do mix, but do not combine for they seem to suffer from a traumatic sense of identity. This is perhaps best reflected in the black groups of the region and in

the phenomenal growth of Black Power consciousness throughout the Caribbean. In other words, the Caribbean is composed of countries with pluralistic societies in which certain "values...permeate the entire social order, but in everyday life...classes remain sharply divided, and divergent social institutions and modes of culture underscore clan divisions". (Lowenthal, 1972)

Plantation Economies

As concerns of economic structures, the general characteristics of the area can be described in terms of plantation economies. Practically all of the Caribbean countries have a skewed type of export trade based on the one-crop mining of products such as bauxite and petroleum or the one-crop harvest of agricultural products such as bananas and sugar. Thus, export earnings constitute a very high proportion of a country's earned income. If tourism earnings were added to those of one-crop exportations, the dependency on external sources of income would be even greater in many countries. However, although Caribbean export efforts may be said to be efficient, they are very vulnerable for, in more cases than not, export efforts are sustained by special commodity agreements with the metropolitan buyer economies.

In short, the region produces what it does not itself consume and consumes what is produced elsewhere.

The region's countries are characterized by one-crop economies based on agriculture and/or mining with virtually no industrial production, excluding Puerto Rico and to a lesser extent Jamaica and Trinidad. (Demas, 1965)

The heretoforesaid describes the essence of the character of the Caribbean's heritage. But in the present period the Caribbean is subjected to new strains and stresses as a consequence of the modernizing process and the americanizing process.

Modernization reflects the process of developing industrialization, urban concentration, population movements, rising consumer expectations, mass communications, rising demands for education, health and other social services. All of these factors were accelerated by the Second World War's impact on the region. Americanization refers to the general fact that modernization is taking place through the filter of the overweening impact and presence of the North American culture and technology on and in the region. These two processes sometimes coincide and at other times can be perceived as separate and distinct culture processes. In brief, the problem of the contemporary Caribbean is: the way in which the area, as shaped by the factors noted above, adjusts itself to the modernizing and americanizing processes.

Up to this point, all of the preceding describes the Caribbean as seen from the viewpoint of nurture, that is, the collective

impact of manmade factors which influence the land-sea balance of the region. However, it can and should also be seen from the viewpoint of nature.

In addition to the many differences in the cultural, social and political values of the various societies in question, as noted, there exist many other factors, primarily natural factors, which propel the territorial units of the Caribbean towards closer relationships. The Caribbean Sea is a common possession. All of the Caribbean countries claim a right to use and exploit the Sea's resources. Furthermore, the area is tropical in nature and the countries within it share similar physical conditions and biotic elements in their terrestrial and aquatic habitats. Consequently, a concern for eco-systems management becomes a link, a common cause.

However, given the massive heterogenous collection of differing cultural and social life-styles, eco-systems management is quite possibly the only common denominator that exists as a base for collective actions is eminently desirable in view of the fact that the region possesses a land-sea relationship of tremendous delicacy. By delicacy we mean that the mismanagement of the region's natural resources can result in a destructive chain reaction producing a fatal ecological imbalance and possibly the destruction of resources that cannot be replaced. This relationship is particularly delicate in islands as opposed to the littorals of the continental masses.

Finally, any discussion of the role that Puerto Rico can play in the Caribbean area must take cognizance of the fact that the Caribbean already possesses a history of over 30 years or more of

various efforts to create Caribbean political and economic structures, and a Pan-Caribbean consciousness. For various reasons, both internal and external, none of these experiments have survived (Anglo-American Commission, 1942-46; Caribbean Commission, 1946-60; Caribbean Organization, 1960-65; The West Indies Federation, 1958-62; and CODECA, 1965-71).

THE ROLE OF PUERTO RICO IN THE CARIBBEAN AREA

"Puerto Rico and the Sea" was convened as a project for the purpose of identifying major marine-related problems and opportunities of concern to Puerto Rico and recommending specific programs that can be implemented by existing private and public Puerto Rican institutions that have a capability for dealing with the Island's marine affairs.

Consequently, this Subcommittee has interpreted its mission as dealing with the identification of marine-related problems and opportunities that are of common concern to Puerto Rico and the countries of the Caribbean and the recommendation of action programs wherein a Puerto Rican initiative can play a major role. Within the light of this mandate, the recommendations of this Subcommittee are based on the following precepts:

1. Puerto Rico can, admittedly, teach the region much but also has much to learn from the region.
2. Given the comparative inefficacy of attempts for formal cooperation among Caribbean countries, primary

emphasis is given to informal and functional cooperation possibilities that can be realized via already existing Caribbean Institutions.

3. Puerto Rico's initiatives in informal and functional cooperation with respect to the marine affairs of the Caribbean region should be conceived and accepted as an opportunity for the development of a new, viable international personality for the Commonwealth.

Puerto Rico Can Teach and Learn

It is well known that Puerto Rico has had an experience of over 20 years of rapid industrialization and socio-economic development with all their favorable effects on the Islands and its inhabitants. This experience can be and often is regarded as an invaluable example for the development-experiments of Caribbean countries in general. In particular, Puerto Rico's concern with the implications and end-effects of industrialization on marine and coastal life have been crystallized in the creation of a number of institutions such as the following:

Environmental Quality Board

Department of Natural Resources

Puerto Rico Planning Board

Puerto Rico Nuclear Center

Water Resources Research Institute

Many of these agencies are the only bodies of their kind in the Caribbean and it is likely that they could be of service and tremendous usefulness to those Caribbean countries that are not in a position to duplicate such institutional efforts. The relative abundance of human resources in Puerto Rico, as well as financial means from both Commonwealth and Federal sources gives strength to such institutions and to the assumption that they could be instrumental in a Caribbean-wide cooperative effort in marine-affairs.

The above mentioned institutions are active in the following areas of ecological concern:

- Control of urban sprawl.
- Control of beach front development.
- Preservation of coastal areas for recreation.
- Preventing the alienation of public beach land via private ownership.
- Controlling the pollution of the Island's land, sea and airspace.
- Studying marine life and coastal vegetation.
- Behavior of estuaries and bays.

These are but a few examples of Puerto Rican experience that can surely be of great interest to other Caribbean countries, both for the purpose of learning from our successes as well as from our failures.

We must now look at those areas where other Caribbean countries have had their measure of success and wherefrom Puerto Rico can learn.

In the first place, there is the issue of tourist development. Especially in the Winward and Leeward Islands, a number of non-governmental groups, primarily student groups and churches, have been concerned with the development of tourist development models that will be indigenous, locally based and with an emphasis on boarding houses and small hotels--as opposed to a hotel industry based on international hotel syndicates--and which will cater to both the local and to the foreign clientele.

In the second place, there is the issue of exaggerated urbanization which now calls for an ecologically sane relationship between city and nature. Most urban planners in the area are concerned with preventing the transformation of a pre-industrial capital city (such as Port of Spain and Fort de France) into an excessively urbanized metropolis such as San Juan.

Alongside of this, note ought to be taken of the growing temper of self-criticism within the Puerto Rican world itself which, frankly recognizes the deficiencies of the Puerto Rican planning record and admits the impropriety of offering the Puerto Rican model indiscriminately as an exportable model.

Thus, Puerto Rico has much to learn by looking at how other Caribbean countries plan and utilize their coastal areas, particularly with reference to tourism and urbanization, both of which directly impinge upon the conservation of the naturally given ecological balance of coastal zones.

In sum, there exists no immaculate concept for Pan-Caribbean development.

Informal and Functional Cooperation

The history of formal Caribbean cooperation has already been noted. Almost certainly, the one lasting lesson that can be gleaned from that history is the non-viability of political solutions, meaning political solutions of either a federal or quasi-federal character or any grand design involving the construction of supra-national organizations. Therefore, the Subcommittee has chosen to emphasize that the growth of the cooperation habit (among Caribbean countries) in marine affairs be pursued with a minimal stress on formal agreements of an international character.

Informal and functional cooperation, as here conceptualized, involves the usage of all public and private associations or institutions that already exist in the region and, thus, emphasizes the road of example and initiative, not exalting the idea that the best results come out of ideology, but rather from cooperative work undertaken for solving limited and particular problems with limited and particular means. This is to say, that the main emphasis will be on the professional ethic.

Puerto Rican institutions should be urged, as per the Subcommittee's subsequent recommendations, to develop working relationships with the institutions of other Caribbean

countries in data gathering, exchange of personnel, joint studies, training, etc. Of course, such relationships can only be developed among institutions that can profit, in some measure, from the relationship. Any kind of cooperation between countries or institutions is pointless unless the participants can expect some benefit for themselves. Those institutions interested in collaborating with one another can themselves specify their own terms and conditions for collaboration and do not necessarily need some supra-national organization or bi-or multi-lateral agreements from their governments to dictate what the terms for collaboration will or should be.

Conceivably, at the outset, working relationships among Caribbean institutions will tend to be loose and non-compromising for the participating parties. However, with the passage of time one can expect that those working relationships will evolve and become stronger and more useful. This is indeed the desirable end-result.

A Puerto Rican International Personality

It has been pointed out that this Subcommittee considers informal and functional cooperation as the best possible

alternative for cooperating with already existing local and Caribbean institutions. It was also indicated that the Subcommittee will make specific recommendations as to areas of activity wherein Puerto Rican institutions can search out contacts and develop working relationships with their appropriate Caribbean counterparts.

In brief, as Puerto Rican institutions, acting on their own initiative, search out and develop informal and functional but lead towards a new role for Puerto Rico, a new personality, a new understanding based upon multi-lateral cooperation, as opposed to strict and antiquated bi-lateral cooperation, as opposed to strict and antiquated bi-lateral relationships. By bi-lateral relationships we mean, for example, such as San Juan looking towards Washington, Fort-de-France looking toward Paris and Kingston looking toward London. By multi-lateral relationships we mean that these two-way streets ought to become multi-lane highways wherein multi-lateral relationships can flourish among Caribbean neighbours; relationships which can only flourish if they are based upon equality and understanding.

SERIAL RECOMMENDATIONS

Education

The Subcommittee is conscious of the fact that Puerto Rico has minimal relations with its Caribbean neighbors. One of the reasons is, as it was expounded in the Introduction, the absence of a "lingua franca" in the region. This frustrates the growth of Pan-Caribbean consciousness. Without the ability to communicate in language, any cooperation at a more specialized levels is made more difficult. Linguistic intercourse can be seen as a sort of necessary infra-structure on which cooperative ventures can be built in regional educational marine and marine-related affairs. It seems logical, therefore, that the Department of Education should undertake a more positive role in regional educational activity.

As a means of strengthening and developing ties with the English speaking Caribbean, Puerto Rico must emphasize the teaching of English. This does not necessarily mean the reinforcement of the North American connection, but it does mean widening the linguistic instruments of the Puerto Rican professional. Therefore, the Subcommittee feels that the Department of Education should seek means for strengthening the teaching of English. It must be kept in mind that in addition to Spanish and English, two other languages are spoken in the Caribbean, namely French and Dutch. These two languages, especially the former, should find their

ways in the curriculum of Puerto Rican high schools. This could be undertaken by consultation with the language laboratory of the U.P.R. and the new translator program at U.P.R.

Recommendation

The Department of Education should further strengthen the teaching of English and investigate the possibility of teaching one or two of the major Caribbean area languages.

Teaching the languages of the area is but one of the many ways of familiarizing the Puerto Rican professionals with the future of the area and ensuring an effective participatory role for Puerto Rico. This alone however would not suffice unless students are made aware of the region as such and of its problems. An additional way is to review and, if need be, revise the curriculum at the high school level, undertake a serious program of revision of text books and plan new text books. This is already being done both in the U.S. Virgin Islands, under the Project Introspection of the USVI Department of Education (with funding being provided under the ESEA Legislation of 1965), and in the English speaking Caribbean, for example, the new text materials being put out by Longmans (London) in the field of secondary school level Caribbean histories.

This will require an enlarged reservoir of teachers trained in Caribbean issues and problems. The Department could easily secure the cooperation of the U.P.R. (Institute of Caribbean Studies,

Office of the President) which in turn can organize university level courses (possibly at Diploma level) for candidates with this end in mind.

Recommendation

The Department of Education should investigate the feasibility of teaching Caribbean-oriented courses at all levels of the school system.

The Subcommittee is also aware of the fact that at present there exists nothing in the way of multi-language dictionary material in any technical field. It appears to the Subcommittee that an excellent way to start an informal and functional cooperation among technical personnel in marine and marine-related affairs would be long-range project on the preparation of a technical dictionary. The Subcommittee also would like to call attention to the fact that the University of the West Indies in Barbados, for example, has recently launched a five-year program for the development of an English Creole grammar.

Recommendation

The Department of Education investigate the possibility of preparing and publishing a multi-language dictionary of technical terms in the marine sciences.

An Office for Caribbean Affairs

At the moment there exists no single office within the Commonwealth Government dealing specifically with Puerto Rican relationships with Caribbean countries. Because the Caribbean is a region of growing inter-territorial and international activity and because Puerto Rico will be drawn increasingly into this activity, it seems advisable that some such office be created. This office would act as a Protocol Office for visiting area leaders, official delegations and others. In addition, this office would, on behalf of the Government, keep abreast of all Caribbean-wide activities and problems of interest to Puerto Rico.

Recommendation

An office for Caribbean affairs should be established within the office of the Secretary of State of the Government of Puerto Rico at the Assistant Secretary level.

Local Studies

Even though the Caribbean communities are "sea-oriented", the region as such does not have enough industries that process resources obtained from the sea. Yet, such industries could help further the economic development of the islands and to improve trade among them. Despite the efforts of CARIFTA, Intra-Caribbean trade is still an insignificant portion of the total trade of the

region. (A McIntyre, 1966 and F. Andic and E. Gutiérrez, 1966). The region because of its natural endowment, can establish several sea-oriented industries that may prove to be viable. The industries, among others, are: (a) those that could obtain marine life such as fish, crustaceans, shell-fish, seaweeds; (b) those that could process sea water to obtain minerals such as salt, bromide, magnesium; (c) those that could obtain and/or process sand, gravel and shells; (d) those that can exploit products which are obtained from sea beds such as petroleum and natural gas.

Although these industries appear to be prima facie viable, a series of studies are necessary to determine the economic and technical feasibility of the establishment of these industries. There are in Puerto Rico a number of agencies such as the Economic Development Administration and the projected Department of Natural Resources which could help make such studies. In order to enhance the applicability and the acceptance of the studies a close collaboration with organizations and institutions in other Caribbean countries is extremely desirable.

Recommendation

A Study should be carried out by an agency designated by the Governor to determine the economic and technical feasibility for the establishment of sea-oriented industries in the Caribbean community.

Recognizing that the consumer and industrial products that can be obtained from these industries can and should be traded among the Caribbean countries as and where needed, it needs to be pointed out that there are but very limited statistics with reference to the market. For trade to flourish among Caribbean countries, adequate information should be exchanged to determine the forces of demand and supply for products obtained from the sea. More specifically, information is needed in the following areas: (a) product demand; (b) product supply; (c) product prices; (d) degree of competition; and (f) consumer attitudes towards marine products.

The availability of information of this nature, in addition to being helpful to those who deal with the sea products in Puerto Rico and elsewhere in the Caribbean, would be particularly helpful to those countries which are designated by the CARIFTA as less developed countries, for example, Antigua, Grenada, St. Lucia, St. Vincent, Monserrat etc. In order to enhance the functional and informal cooperation among existing institutions of the region, a close collaboration should be sought with appropriate entities in this field. Given the nature of the study, its priority and its first impact, the CARIFTA Secretariat should be given primary consideration.

Taking into consideration the importance of the above mentioned studies and their possible impact and trade and development for the area in general and the enhancement of marine oriented industries in particular, the Subcommittee feels that it is very

important to set a definite deadline for the completion of the individual studies.

Recommendation

The Department of Commerce should conduct a market research study of the Caribbean in the areas of product demand and supply, product prices, degree of competition, and consumer attitudes towards products obtainable from the Sea. The Department of Commerce should also actively seek the collaboration of CARIFTA's Secretariat for carrying out these studies. The studies should be completed within 12 months from the date of inception and the results be made available as soon as possible to those countries, institutions or persons that request and have a need for such information.

Considering that the area generally lacks the financial capability of supporting the industries based on marine products, considering the importance of financial mechanisms in the regional trade of such products, and considering the importance of improved financial possibilities for trade and development in general and marine-oriented industries in particular, the Subcommittee suggests that a common denominator would be the possibility of Puerto Rico joining the CARIBANK. The Bank has a number of non-borrowing members, some of which are outside of the Caribbean area (Venezuela and Colombia). Since the bank is an outstanding organization, both in terms of its influence and its importance for cooperation

and the consolidation of development and trade in the area, the Subcommittee feels that Puerto Rico may benefit and in turn contribute to the efforts of the Bank, if it is clearly determined that Puerto Rico's participation is feasible.

Recommendation

The Government of Puerto Rico should prepare, within six months, a technical and economic study on the feasibility of Puerto Rico joining the CARIBANK as one of the non-borrowing equity holders.

Communications

The development of an issue on the subject of communications appears at first glance to be scarcely related to marine affairs. However, one cannot expand on the subject of communications without influencing, in some way, the marine affairs of our region. For example: telephone and telegraph communications may involve the laying of underwater cables and the establishment of shore installations; postal communications may involve sea or air transportation and the expansion of harbor or airport communication installations (both of which are usually established in coastal areas).

It is a well-known fact that Puerto Rico is becoming a communications "link" of sorts for the countries of the Caribbean. A large number of passengers who fly between Caribbean countries

and the United States or Europe are shunted through Puerto Rico. In terms of maritime cargo, Puerto Rico is becoming a transfer point for the Caribbean, i.e., ships travelling from the United States and Europe transport Caribbean cargo to Puerto Rico, where it is transferred into smaller vessels that ply the Caribbean trade (the opposite also occurs: Caribbean cargo is brought to Puerto Rico where it is transferred onto large vessels for further shipment). Furthermore, the Puerto Rican Department of Commerce is stimulating our local industries to trade more with other Caribbean countries. Lastly, Puerto Rican tourists are increasingly vacationing in other Caribbean countries. All of the above, taken collectively, underlines the need for improved communications between Puerto Rico and other Caribbean Countries.

At present the Caribbean communications network leaves much to be desired. Telephone calls between Puerto Rico and other Caribbean countries must be shunted via Miami, in other cases via New York, London or Paris. Postal communications take too long, Telegraph and Telex communications are not currently able to satisfy customer demands. If Puerto Rico's collaboration with other Caribbean countries is to be promoted with respect to marine affairs, then, we must point out that in order to realize efficiency in cooperation, Puerto Rico must be able to depend on the efficacy of its communications systems.

Recommendation

The Government of Puerto Rico should invite Caribbean countries to a conference for the purpose of considering the improvement of communications systems. The participants should also weight the effects which communication installations may have on the ecological balance of our region.

Transportation

Puerto Rico is becoming an increasingly important cargo transfer point for the Caribbean. This means that shipments from the United States and or Europe are sent in bulk to Puerto Rico, where said cargo is transferred to smaller ships and aircraft for further distribution in the Caribbean. The inverse also occurs.

As trade increases among the countries of the Caribbean, and as cargo through Puerto Rico increases, Puerto Rico as well as all the other countries are called upon to expand their harbor and airport facilities. This expansion is inevitable because trade is the key to the social and economic prosperity of the region. The construction of harbors and airports has always had a detrimental effect on the coastal areas of the countries of our region. In order to construct an airport, large tracts of land have to be covered with cement and modern jet airplanes contribute to the further pollution of our environment. Likewise, the development of harbor facilities involve the use of water frontage for the construction of docks and warehouses. Ships also can contribute

to the further pollution of our environment through oil and garbage spillages.

It would be wise to attempt to arrive at a certain meeting of minds with other Caribbean countries as concerns the use of coastal areas for the construction of airports and harbors. Instead of having a haphazard development of such facilities throughout the Caribbean, our region could benefit from the development of an overall plan whose purpose would be to insure the protection of our region's natural habitat.

Recommendation

The Government of Puerto Rico should sponsor a conference of Caribbean countries in order to discuss the various aspects of airport and harbor development and their possible impact on the ecological balance of our region.

Interchange and Conferences

The countries within the Caribbean Basin are regarded by many as members of a geographic system having similar or common social, economic, and cultural backgrounds. This, as was discussed in the introduction, is a gross exaggeration. The region is a massive heterogeneous collection of different cultural and social life-styles, and is also characterized by a fundamental inequity of economic development.

The tropical characteristics of this region, its physical framework, its dependence on activities around the same marine natural system, and many other common environmental factors, have made of the Caribbean an area where the principles for inventorying scientific information and their practical application are essentially the same. Common needs exist, but unfortunately divergent territorial attitudes for their solution have rarely found a common Caribbean interest, so as to effectively promote the necessary technical exchange and cooperation.

Up to the present, most of the technical exchange of ideas, assistance and publications between Puerto Rico and the countries of the Caribbean has been made through rather localized if not fully person-to-person relationships. Very little official attention is given to regional professional meetings. Outside the immediate interest of individuals, very little is done to sponsor the holding of regional meetings or to generate interest for them. Puerto Rico's interest has been lagging behind what it was, instead of increasing.

Marine-oriented research carried out by Puerto Rico and other Caribbean countries must be shared for the communal benefit of all the people living in this semi-closed oceanic basin. Unless conferences, seminars and other technically oriented meetings are sponsored by the governmental instrumentalities and professional organizations of these countries, the information gathered through costly and painful research, will seldom reach those national or

international public and private sectors capable of their practical application. Thus, a wealth of good information rarely receives a practical trial due to the lack of well-established communicating media.

Improving the relations of Puerto Rico with other Caribbean countries in the area of marine affairs is a necessary preliminary step towards promoting the active cooperation of the island in regional affairs. Already existing institutions can be of great help in this direction. In this respect the North-South Center is well equipped to act as a coordinating institution for any regional effort aimed at technical and cultural interchange in marine affairs. (See Appendix A, charter of North-South Center.)

Furthermore, the North-South Center can and should promote and help to organize regional meetings for professional groups and societies interested in marine affairs. For example, a series of conferences sponsored by the Center can discuss in a systematic fashion topics such as: marine archeology, coastal and marine geology, coastal and marine living resources, etc. Professional meetings of this nature might also lead towards agreement for the establishment of regional mechanisms to deal, on a regular and professional basis, with problems of common concern.

Recommendation

The North-South Center should be instructed by the State Department to undertake immediately technical exchange and the

organization of conference on marine-related affairs.

The Subcommittee is quite conscious of the fact that this mandate — in addition to human resources — requires considerable financial resources.

Recommendation

The North-South Center should be funded adequately to carry out its mandate effectively and efficiently; in addition, North-South Center should be assisted in the search for additional local, Federal and International sources of funding for the activities requiring expenditure beyond its enlarged budget assignments for such purposes.

Publications

As pointed out previously, this Subcommittee strongly believes that cooperation among Caribbean countries can best succeed through the development of informal and functional relationships. Thus, we feel that the Government of Puerto Rico should sponsor the printing of certain publications which would facilitate the exchange of technical marine-related information among Caribbean countries.

Recommendation

The Government of Puerto Rico should sponsor through the North-South Center: (1) An annual publication that could be

called "Status of Marine Research in the Caribbean"; (2) The publication of an annual "Bibliography of Technological Publications" that would deal with the scientific and technological efforts of the Caribbean.

Information Clearing House

A recurrent problem in the contemporary Caribbean arises from the exponential increase in the information available on any given topic. Poor utilization of this information leads to incertitude in the establishment of priorities, redundant research, and general failure to employ successful exploitation techniques developed in other areas.

Utilization of information resources involves two facets: compilation and dissemination. Puerto Rico is already rich in information repositories for the compilation and accumulation of information on a variety of subjects. Many of these repositories (North-South Center, U. of Puerto Rico, Interamerican U.) have extant active ties throughout the Caribbean area. Some of the professional organizations and agencies active in this line are listed in Appendix B.

Adequate compilation facilities currently exist, but there remains still an obvious yet solvable problem in effecting the flow of information on a variety of topics throughout the Caribbean. (See also "Ocean Resources Data Bank", report of the Subcommittee on Research and Development.)

The problem of information flow should be approached by the formation of an "Information Clearing House" whose primary mission is the dissemination of information regarding:

1. Scientific Research pertinent to the Caribbean Basin.
2. Information affecting the flow of people and goods throughout the Caribbean Basin, including up-to-date information on tourism, shipping, and commerce.
3. Information on cultural, educational, and technological exchange opportunities that exist throughout the Caribbean Basin.
4. Promotion of rational marine resource development throughout the Caribbean Basin through providing and stimulating international ventures involving optimal use of the environment, coupled with sound economic and cultural considerations.

The above-mentioned goals of the "Information Clearing House" can be accomplished through immediate initiation of actions to coordinate and catalogue the information resources of both Puerto Rico and countries surrounding the Caribbean Basin. It is suggested that this be accomplished through the awarding of 5 graduate fellowships to be given to students of both Puerto Rican and Caribbean origin. The work to be accomplished by these students should be directed by a committee composed of the U.P.R., the North-South Center, and Institute of Social Technology and should result in a comprehensive catalogueing of the information resources of and

relevant to, the Caribbean Basin. The students should be from varied disciplines to insure completeness of the effort.

The second phase of the Clearing House can begin concurrently with the first and should consist of the active development of a network of information exchange. Wherever possible exchange should involve electronic means of transmission but it is realized that this is dependent on the somewhat inadequate communication network that exists within the Caribbean at present.

Although this network is to be initiated in Puerto Rico, it should be truly international in both staff and use. It is suggested that the priorities for establishment be as follows:

1. Locate an institutional base for the Clearing House operation.
2. Establish an organizational board from a variety of disciplines to establish international ties and to supply direction to the program.
3. Establish regional centers throughout the Caribbean primarily through already extant libraries and academic facilities.
4. As new electronic facilities become available, computerization of the Information Clearing House should be undertaken.

Fiscal support for the Clearing House in its first year should not be less than \$50,000 and should be expended for graduate student support, salary for a primary advisor, and travel within

the Caribbean Basin in order to initiate information exchange. Subsequent funding is somewhat dependent on the availability of electronic communications media but should probably be in excess of \$250,000 for the first 3 years. Partial support should develop from subscriptions to various aspects (business, travel, commerce) of the information service by commercial enterprises, as those services become available.

This Information Clearing House would serve to promote and foster Caribbean unity through its emphasis on the mutual benefits obtainable through cooperative efforts at all levels.

Recommendation

The Government of Puerto Rico should provide adequate funding for the establishment of an Information Clearing House for Caribbean-related data and information as per the above-mentioned concepts.

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APPENDIX A

Articles 4, 5 and 6 of Puerto Rico Law 92 (June 24, 1971), which created the North-South Center.

Article 4

It is the intent of the Government of the Commonwealth of Puerto Rico that the Center carry out the following objectives:

1. Carry on exchange programs of an educational, research or cultural nature for North, Central and South America and the Caribbean.
2. Contribute to the development of the capability of the peoples of North, Central and South America and the Caribbean to deal with present and future problems in all fields of economic, social and cultural growth by orienting the programs of the Center toward problem areas.
3. Develop multicultural perspectives by means of educational, research and training programs.
4. Foster greater interaction between the different cultures, disciplines, professions and occupations in the Americas.
5. Improve the standard of living and individual development of the inhabitants of the Americas.

6. Improve relations between the peoples of the Americas in all fields of human activity.
7. Maintain a continuing exchange among the ex-participants in the programs of the Center.

Article 5

The Center shall exercise all the rights and powers that are necessary or convenient to carry out the purposes of this act, including, but not limited to, the following:

1. To carry out surveys and research in the fields of economic, technical, social, cultural, or any other kind of cooperation.
2. To administer programs aimed at achieving a greater exchange of persons and ideas among the countries of North, South and Central America and the Caribbean, including, but not limited to, developing local scholarship programs, and to administer scholarship programs of the Government of the United States, its agencies, territories, possessions or political subdivisions and of the states of the Union or of foreign countries or international or regional organizations.

3. To carry on conferences, seminars, study groups and to promote the use of other educational techniques to stimulate constructive dialogue among participants in exchange programs.
4. To enter into contracts for services or of any other nature, and to utilize any other instruments which are necessary or convenient to the exercise of its powers.
5. To offer technical or specialized services to governments and persons, or public or private entities, local or foreign, and to request such services from said governments or entities.
6. To determine, fix, alter, levy and collect rents, tariffs, fees and other charges for the rendition of services, use of properties or facilities, or for goods sold, lent or supplied and make exemptions from payment for all or part of the same.
7. To accept funds or economic aid of any kind from any natural or juridical person or political entity, private or governmental, operating or functioning locally or internationally, or in the United States of America, and to agree with said persons or entities on the use of said funds.

8. To adopt, amend or repeal, with the approval of the Secretary of State, and in accordance with the provisions of Law 112 of June 30, 1957, rules and regulations regarding its internal functioning and its exercise of powers granted it and the duties imposed on it by this law.
9. To undertake all those incidental acts which are necessary or desirable for carrying out the powers granted it by this law or any other law in force in Puerto Rico.

APPENDIX B

PARTIAL LIST OF AGENCIES AND PROFESSIONAL ORGANIZATIONS THAT HAVE TIES THROUGHOUT THE CARIBBEAN AREA

A. Puerto Rico Government Agencies

1. Economic Development Administration
2. Department of Public Works - Natural Resources
3. Environmental Quality Board
4. Puerto Rico Planning Board
5. Department of Health
6. Aqueduct and Sewers Authority
7. Water Resources Authority
8. Highways Authority
9. Department of Transportation
10. Public Service Commission
11. Bureau of Tourism
12. Puerto Rico Nuclear Center
13. University of Puerto Rico
14. North-South Center
15. Puerto Rico Mining Commission
16. Department of Commerce
17. Compañia de Desarrollo Comercial

B. U. S. Government Agencies

1. U. S. Geological Survey
2. U. S. Corps of Engineers
3. National Oceanographic and Atmospheric Administration
4. U. S. Postal Service
5. U. S. Soil Conservation Service
6. U. S. Bureau of Mines
7. U. S. Environmental Protection Agency
8. U. S. Atomic Energy Commission
9. U. S. Bureau of Public Roads
10. Institute of Tropical Forestry (U.S.D.A)

C. Private Organizations

1. Institutions of Higher Learning
 - a. University College of the Sacred Heart
 - b. Puerto Rico Junior College
 - c. Inter-American University
 - d. World University
 - e. Catholic University, Ponce
 - f. Bayamon University

2. Academies

- a. Puerto Rico Language Academy
- b. Puerto Rico Hispanic Academy
- c. Puerto Rican Academy of Arts and Sciences
- d. Society of Puerto Rican Authors
- e. Society of Puerto Rican Editors
- f. Institute of Puerto Rican Culture
- g. Atheneum of Puerto Rico
- h. Puerto Rican Historical Society
- i. Puerto Rican Society of Natural History
- j. Puerto Rican Society of Lexicography
- k. Carnegie Institute

3. Professional Associations and Institutions

- a. Puerto Rican Medical Association
- b. Puerto Rico Industrial Association
- c. Puerto Rico Bar Association
- d. College of Pharmacists
- e. College of Dental Surgeons
- f. College of Chemists of Puerto Rico
- g. College of Engineers, Architects and Surveyors
- h. Puerto Rico Farm Bureau

- i. Supreme Council of Associations of Puerto Rico
- j. Geological Society of Puerto Rico
- k. Chamber of Commerce
- l. Caribbean Conservation Association

D. Quasi-Governmental Institutions

- 1. Institute for Social Technology
- 2. Puerto Rico International Underwater Laboratories

COMMITTEE MEMBERS

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Chief, Ocean Islands Programs
U.S. Environmental Protection
Agency

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Associate Professor
School of Public Administration
University of Puerto Rico

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Rúa

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Public Service Commission

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